The Oil and Gas Journal

PUBLISHED WEEKLY BY THE PETROLEUM PUBLISHING COMPANY AT TULSA OKLAHOMA

HOME OFFICE, 211 S. CHEYENNE, TULSA
PHONE 3-6291

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Table of Contents

Vol. 39, No. 27 — November 14, 1940

News Developments

Trends: Market Improvement Brings Advances in Pennsylvania Grade ... 51
Oil Industry Ready: Theme of A.P.I. Sessions ... 52
Petroleum Industry Photographic Salon ... 55
Record Demand for Crude and Products in 1941 ... *J. P. O'Donnell* 56
Increased Drilling Activity Is Seen for Mid-Continent ... *W. V. Howard* 57
Sparks From the News ... 60
Excess-Profits Tax Strikes Most at Medium-Sized Industries ... *Roy F. Godfrey* 61
Pennsylvania Crude Market Hits Comeback Trail ... 62
Editorial: As Regards Outlook ... 63
News From the State Capitals ... 64
Industry Facing a State of Flux With Return of Administration ... *Henry D. Ralph* 67
Jersey Standard Defines the Gasoline Situation ... 68
Shifting Crude Stream ... 68
Pacific Section of A.A.P.G. and S.E.P.M. Meet in Los Angeles ... *L. P. Stockman* 71
S.A.E. Speaker Predicts Upsurge in Aviation ... *W. T. Ziegenhain* 72
American Recycling Association Formed at First Short Course ... *George Weber* 75
International News ... 77
Natural-Gasoline News, Refinery Construction, and Natural-Gas News ... 78
Programs and Meetings ... 80
Finding of Deeper Pay Revives Iowa Field in South Louisiana ... *Neil Williams* 82
New Pool in Prospect in Gallatin County, Illinois ... *W. Farrin Hoover* 87
Claim Panhandle and Hugoton Gas Reserves Ample to Supply Wisconsin Markets ... 88
Well Logs and Field Data of Active Oil Areas: South Central Oklahoma ... 122
Pipe-Line Activity ... 225
California Dry-Gas Reserves ... *L. P. Stockman* 253

A. P. I. Section

The American Petroleum Institute Can Answer Through Its Record ... 89
Continuous Logging at Rotary Drilling Wells ... *J. T. Hayward* 100
Emulsion Deoiling Process ... *A. H. Schutte* 113
Synthetic Chemicals From Petroleum ... *L. Rosenstein* 118
Economics of Controlling Water Produced With Oil ... *J. U. Teague* 125
Protection Against Static Electricity ... *J. M. Pearson* 140
Fluid-Meter Research at University of Oklahoma ... *W. H. Carson and E. E. Ambrosius* 143
Use of Azeotropic Distillation in Separating Hydrocarbons From Petroleum ... *Frederick D. Rossini, Beveridge J. Mair, and Augustus R. Glasgow, Jr.* 158
Oil Recovery by Air Drive in Venango Fields of Pennsylvania ... *Parke A. Dickey and Robert B. Bossler* 161
Use of Lecithin in Gasoline ... *H. V. Rees, W. S. Quimby, and J. C. D. Oosterhout* 176
Factors Affecting Reservoir Performance ... *R. D. Wyckoff* 188
Hydraulics of Mud-Circulating Systems ... *Wesley W. Moore* 208
A.P.I. Pipe-Coating Tests: Final Report ... *Kirk H. Logan* 216

Engineering—Operating

Questions on Technology ... *W. L. Nelson* 223
Other Engineering Articles will be found in the Special A.P.I. Section ...

Field Developments

Field Developments ... 227
N. Louisiana, Arkansas *George Weber* 228
California ... *L. P. Stockman* 229
Oklahoma ... *Dal Dalrymple* 231
Eastern Texas ... *R. Marne Sanford* 233
Indiana, Ohio, Kentucky ... 234
Kansas ... *Dal Dalrymple* 235
Forest City Basin ... 235
Southwest Texas ... *F. L. Singleton* 238
Permian Basin, Panhandle ... *R. Marne Sanford* 239
Rocky Mountain Area ... *T. R. Ingram* 242
North Central Texas *R. Marne Sanford* 243
Texas Gulf Coast ... *Neil Williams* 245
Among Drilling Contractors ... 246
Louisiana Gulf Coast ... *F. L. Singleton* 248
Illinois ... 249
Appalachian Fields ... 251
Canada ... *Victor Lauriston* 255
Michigan ... *Otto C. Pressprich* 256
Mississippi ... *George Weber* 257

Markets and Prices

Group 3 Market ... *H. Stanley Norman* 262
New York Market ... *J. P. O'Donnell* 263
A.P.I. Refinery Report ... 263
Tank-Wagon Market ... 264
Refinery Prices ... 265
Crude-Oil Prices ... 269

Additional Features

Record of Oil Securities ... 259
Personal Paragraphs ... 260
Equipment News ... 266
Classified Advertising ... 268-269
Advertisers' Index ... 270

SUBSCRIPTIONS: United States, 1 year, $6.00; 6 months, $3.00. Elsewhere, 1 year, $7.00; 6 months, $3.50. SINGLE COPIES: 20 cents each. Back copies, when over a year old, 50 cents. CHANGES OF ADDRESS reaching the Tulsa office of the Journal by Saturday take effect with the following issue.

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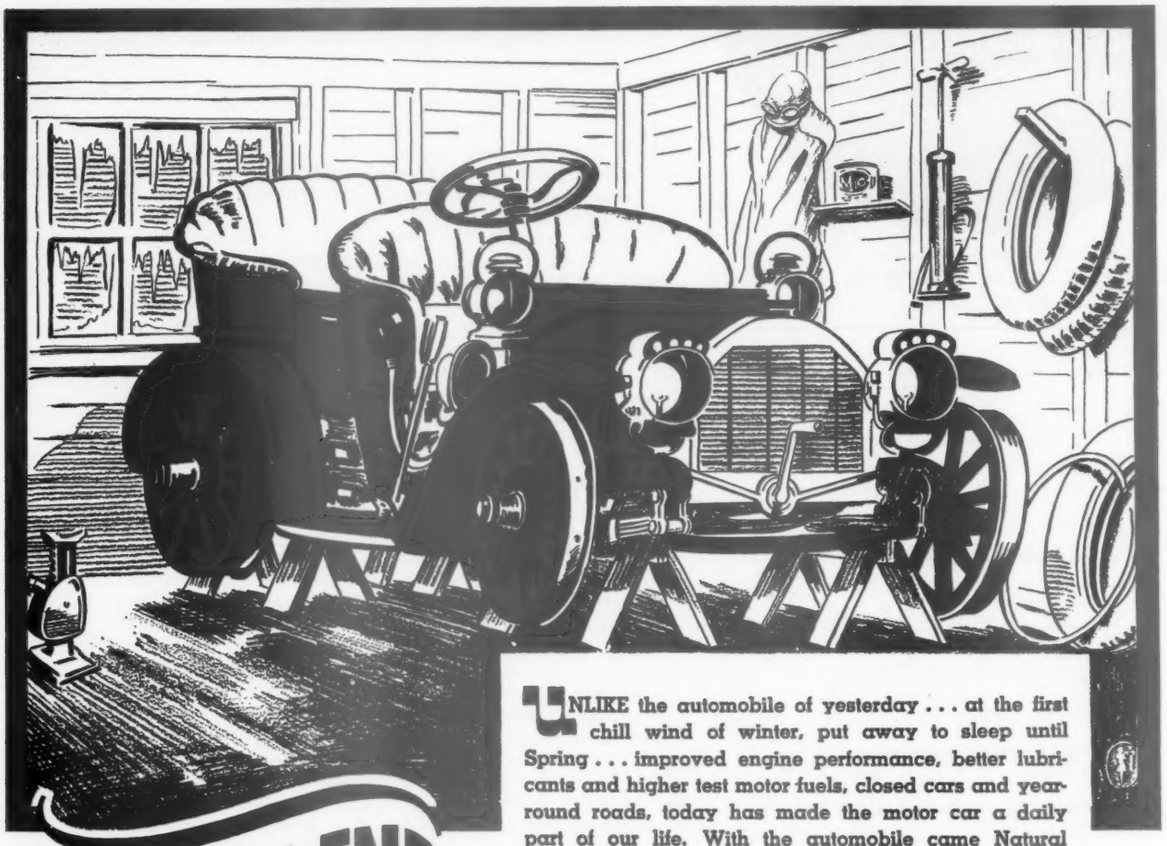
....and Winter came-1908



UNLIKE the automobile of yesterday . . . at the first chill wind of winter, put away to sleep until Spring . . . improved engine performance, better lubricants and higher test motor fuels, closed cars and year-round roads, today has made the motor car a daily part of our life. With the automobile came Natural Gasoline—an Industry small in the beginning, for the daily capacity of the first Hanlon plant built in 1908, was only a few barrels per day. Today Hanlon-Buchanan supplies domestic, coastwise and foreign markets with thousands of barrels of uniform high quality Stabilized Natural Gasoline.

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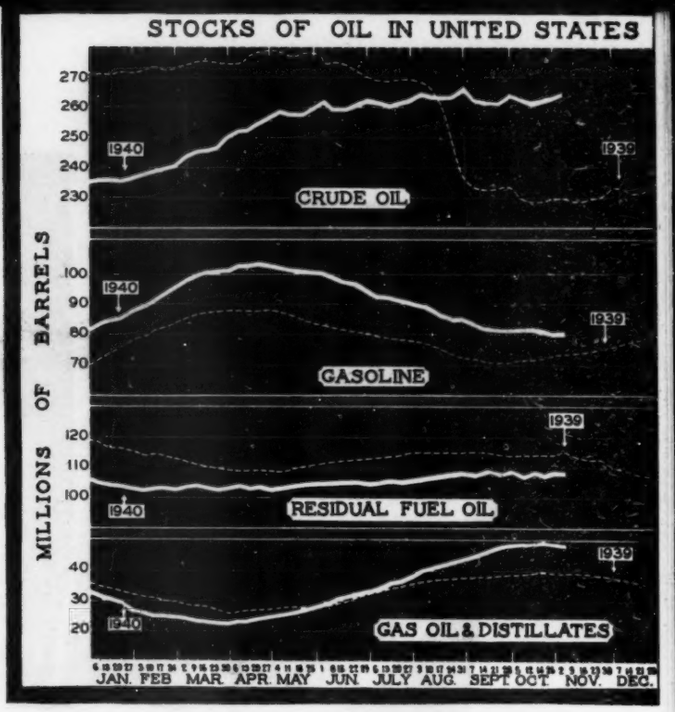
Trends

Market Improvement Brings Advances in Pennsylvania Crude



A 15-CENT advance in Pennsylvania Grade schedules and a minor adjustment upward applying to small purchases in a Mid-Continent area, were the principal developments of the week applying to crude oil. In refinery markets while many feel that the statistical position of gasoline is showing steady improvement, price reductions in that product for the 7-day period were more important than the increases. There were no important changes in other products with furnace oils and other distillate cuts experiencing a strong seasonal demand.

The Pennsylvania Grade advance in the language of that area "starts another cycle." Crude-oil and refinery markets in that section are the most sensitive of the industry having experienced several ups and downs of major importance in recent years. A year ago Pennsylvania Grade crude oil and lubricating oils were exceptionally strong due largely to a heavy war demand for the oils. Early this year the export sales dropped sharply and prices for crude and the lubricating oils reacted before the half-year was over. As usual the low prices brought curtailments in the production of both crude oil and refinery output and domestic buying has been more active. Refinery quotations on lubricants have strengthened and this development accounts for the higher crude posting effective Tuesday.

CRUDE PRODUCTION *3,596,000 bbl. daily average—up 126,115 bbl. One year ago 3,498,024 bbl.*

CRUDE STOCKS *263,820,000 bbl. as of November 2—up 1,074,000 bbl. One year ago 230,453,000 bbl.*

GASOLINE STOCKS *80,774,000 bbl. as of November 2—down 117,000 bbl. One year ago 73,550,000 bbl.*

RESIDUAL FUEL-OIL STOCKS *108,199,000 bbl. as of November 2—down 276,000 bbl. One year ago 113,749,000 bbl.*

GAS OIL AND DISTILLATES *48,615,000 bbl. as of November 2—down 278,000 bbl. One year ago 39,946,000 bbl.*

REFINERY RUNS *3,535,000 bbl. daily week ended November 2—down 30,000 bbl. One year ago 3,556,000 bbl.*

(Figures for week ended November 9 delayed)

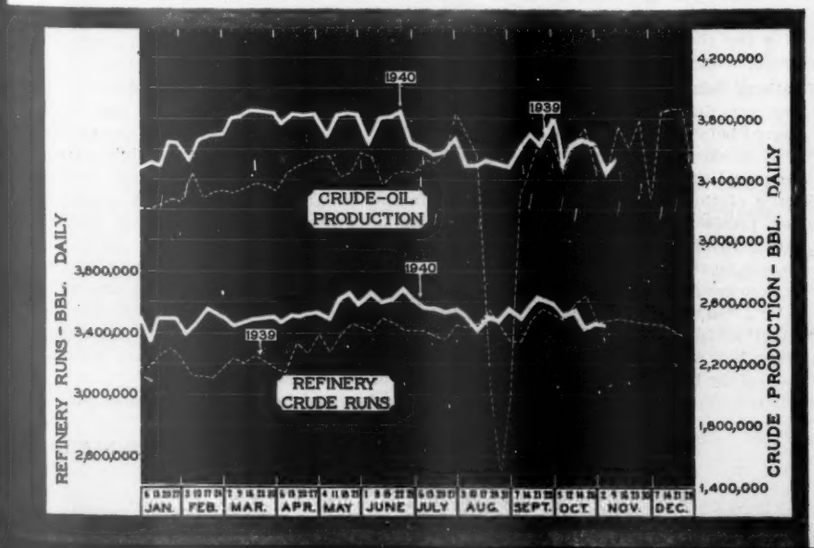
The industry generally is keeping in close touch with crude-oil-production reports in other areas as the key to market trends over the remainder of 1940 and early 1941. Conditions by areas up to the first of the month are revealed in the B. of M. reports covering crude-oil inventories. For the 4 weeks ending November 2 crude-oil stocks in the United States increased 1,269,000 bbl. This gain was divided about equally between California and the fields east of that state.

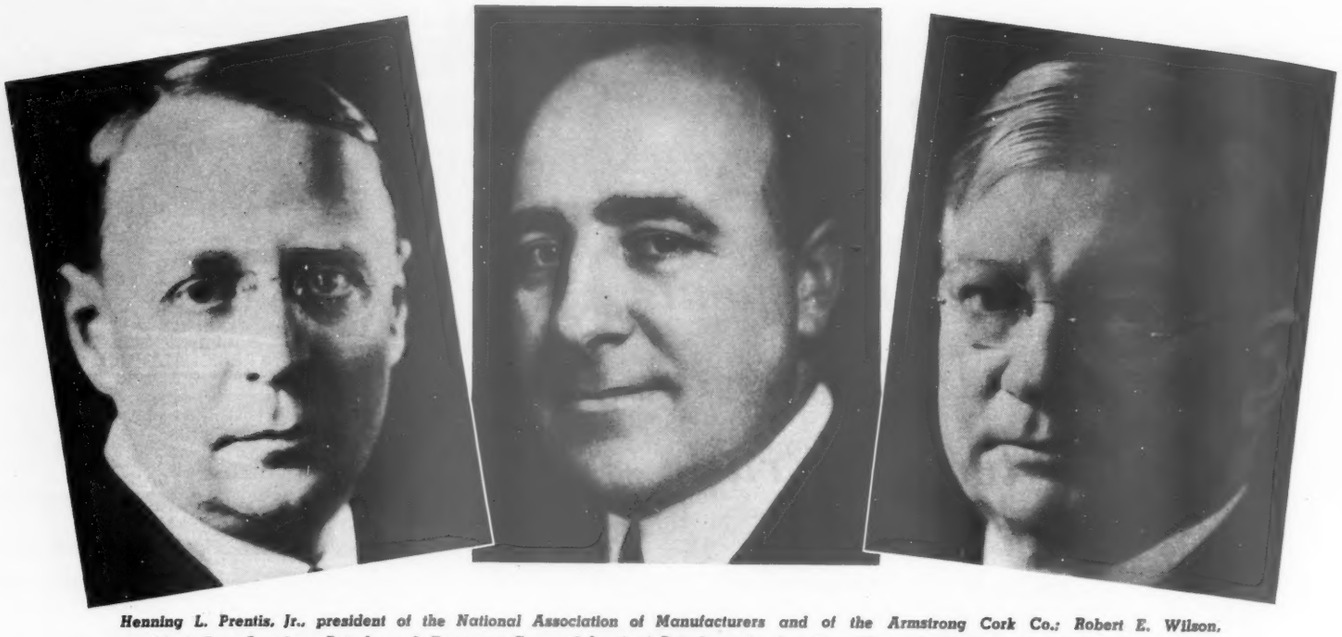
DAILY AVERAGE PRODUCTION FOR WEEK

	Nov. 9 1940	Bur. Mines Nov. est. of demand	November state allowables	Nov. 2 1940
Arkansas	69,375	71,000	69,508	69,175
California	616,250	583,000	571,000	582,750
Eastern states	105,200	100,600	.....	104,700
Illinois	344,430	385,000	.....	348,800
Kansas	168,950	186,000	190,000	182,700
Louisiana	279,990	274,000	279,973	282,085
North Louisiana	*67,040*	.....	.....	*67,235*
Louisiana Gulf Coast	*212,950*	.....	.....	*214,850*
Michigan	47,500	51,000	.....	47,175
Mississippi	16,670	13,800	.....	15,300
Nebraska	3,000	.....	.....	2,250
New Mexico	103,770	104,000	104,000	103,780
Oklahoma	392,825	413,000	390,000	394,500
Rocky Mountain states	99,060	97,600	.....	95,440
Texas	1,350,400	1,291,000	1,304,200	1,241,250
East Texas	*374,850*	.....	.....	*301,400*
West Texas	*228,850*	.....	.....	*221,150*
North Central Texas	*137,500*	.....	.....	*128,950*
East Central Texas	*77,950*	.....	.....	*72,300*
Texas Panhandle	*74,200*	.....	.....	*86,450*
Texas Gulf Coast	*357,500*	.....	.....	*322,350*
Southwest Texas	*99,550*	.....	.....	*108,650*
Total United States	3,597,420	3,570,000	.....	3,469,905

These general figures do not reveal the important situations existing in several areas east of California. While there was an increase in crude-oil stocks applying to the entire section, important reductions materialized in the Appalachian area, Indiana-Illinois, Oklahoma and the Rocky Mountain states. During the same period, crude-oil stocks in Arkansas, Kansas, South Louisiana and Texas increased. More important than the combined increases or decreases in other areas was the 2,521,000-bbl. addition to the crude-oil inventories of Texas during the 28-day period. This gain was scattered throughout the state.

Since the first of the month the Texas Railroad Commission has issued an order canceling many of the exemptions to shutdowns. If this latest order is enforced and there is no offsetting action there should be an immediate reduction of around 100,000 bbl. daily in the production of the Lone Star State.


REFINERY RUNS - BBL. DAILY
CRUDE PRODUCTION - BBL. DAILY
CRUDE-OIL PRODUCTION
REFINERY CRUDE RUNS
1940
1939
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.



Henning L. Prentis, Jr., president of the National Association of Manufacturers and of the Armstrong Cork Co.; Robert E. Wilson, president, Pan American Petroleum & Transport Co., and head of Petroleum Section, Raw Materials Division, of the Advisory Commission to the Council of National Defense, and William J. Cameron, Ford Motor Co., who were among the general speakers at A.P.I. sessions

Oil Industry Ready: Theme Of A.P.I. Sessions

CHICAGO, Ill., Nov. 12.—The opinion that the oil industry would battle the antitrust suit of the Department of Justice every step of the way was freely expressed among the 3,000 oil men attending the twenty-first annual meeting of the American Petroleum Institute here this week. This opinion was based on the fact that the industry, in the knowledge of its freedom from guilt, was confident that its case could not be other than sustained.

There was substantial evidence in the informal, lobby discussion that the industry entertains no thought of a consent decree, such as has terminated other industrial antitrust suits brought by the Department of Justice. The oil industry viewed the attitude of Government, as expressed in the terms of the suit, as a threat to its established methods of operation. A surrender to this attitude would mean a revolution in the industry, a revolution that might seriously disturb its enviable labor record of high wages and short hours and its equally enviable production record of constantly providing better products at lower prices. The attitude of the men at the A.P.I. meeting is that the industry should utilize every resource at its command to defend this highly creditable record against the threat to its maintenance which the federal accusations imply.

It was learned during the meeting that a delay had been granted the defendants in the suit in which to file their answers. The delay, to January 15, 1941, was granted by Judge David A. Pine, of the United States District Court, for the District of Columbia, in which the suit was filed September 30.

Ordinarily defendants in such cases have 20 days from the time at which they are subpenaed in which to appear. Most of the 300 defendant companies, including parent and subsidiary corporations, have been subpenaed.

The 1941 midyear meeting of the A.P.I. will be in Tulsa. San Francisco was selected as the host city for the 1941 annual meeting.

National Defense Stressed

Three other problems shared in the "off-the-record" discussions: National defense and the role that oil may be called upon to play in it, the prospects of demand in 1941, and Illinois. Discussions of national-defense problems revealed the industry's high degree of preparedness to meet any requirement which the Government may ask. These discussions indicated that the industry's present facilities are adequate in every respect to meet defense demands that might normally be expected of oil and that the industry is not only ready but anxious to cooperate in meeting any abnormal demands that the Government might make.

The subject of national defense, uppermost in the national mind today, was the principal subject of the addresses delivered before the Institute's general sessions. These speakers included the Institute's executive vice president, W. R. Boyd, Jr., who spoke in the absence of the president, Axtell J. Byles; T. H. Barton, president, Lion Oil Refining Co., El Dorado, Ark.; Dr. Robert E. Wilson, in charge of the Petroleum Section, Raw Materials Division, Advisory Commission to the Council of National Defense; W. J. Cameron, Ford Motor Co., Detroit, Mich.; H. W. Prentis, Jr., National Association of Manufacturers, New York, and Rep. Martin Dies, Texas, chairman of the Dies committee, Washington.

Mr. Boyd brought the subject of national defense before the meeting when he disclosed the fact that the American Petroleum Institute is undertaking an immediate survey of the nation's gasoline storage facilities to devise means of safeguarding stocks against possible military attack and sabotage. Mr. Boyd said that the Institute had accepted an invitation of the National Defense Commission to undertake the work, is creating committees representative of the entire industry to promote the project and is holding informal discussions of survey plans during the current meeting.

Engagement of the petroleum industry's physical, financial and technical capacities in solving the aviation-gasoline storage problem was visualized as the goal in the program.

A committee, recommended by the A.P.I. and composed of nine of the leading oil men of the nation, was appointed November 9 at Washington by Edward R. Stettinius, Jr., member of the National Defense Advisory Commission, to cooperate with the Army and Navy in the storage program. Protection of military stocks against attack and sabotage is of first importance. Behind the committee appointment, however, was seen the possibility that the industry's resources may be used more extensively in obtaining action on the storage program which has been delayed repeatedly by red tape in Washington for nearly 2 months.

The committee was created to make specific surveys and recommendations for vitalizing the military petroleum-storage program. Technical experts will be available through members of the committee for dealing with the problems that are causing the delays in Washington.

The committee members are: W. S. Farish, presi-

dent, Standard Oil Co. (New Jersey); W. S. S. Rodgers, president, the Texas Corp.; W. G. Skelly, president, Skelly Oil Co.; H. D. Collier, president, Standard Oil Co. of California; J. Howard Pew, president, Sun Oil Co.; J. C. Hunter, president, Mid-Continent Oil and Gas Association; George A. Hill, Jr., president, Houston Oil Co.; Henry M. Dawes, president, Pure Oil Co., and J. Frank Drake, president, Gulf Oil Corp.

Industry's Capacity Adequate

Capacity of the petroleum industry to meet whatever requirements are made upon it by the defense program again was spread before eyes of the public and the oil men attending the A.P.I. meeting.

Colonel Barton and Dr. Wilson, two of the oil men among the general session speakers, probed facilities of the industry and concluded that they are sufficient to serve this nation regardless of the nature or extent of the demand, both in peacetime and at war.

"In view of the indispensable position its products hold," Colonel Barton declared, "it is well that the petroleum industry take inventory of its facilities and examine critically its adequacy to meet any eventualities which the future may bring to these shores.

"Within the last two decades the number of producing oil wells in the United States has nearly doubled. Wells are drilled today five times as fast as 10 years ago. Continuous exploration is opening new fields, and scientific advancements have given us means of restoring productivity to old fields."

Warning was sounded against a foolish complacency, and Colonel Barton emphasized that the industry must roll up its collective sleeves and maintain harmony within the ranks at all times. The industry must maintain itself in a state of preparedness to cooperate with defense measures and to serve whatever duties authorities may demand. "From the roustabout on the derrick floor to the topmost executive," Colonel Barton concluded, "from the sand and mud of derrick-studded fields to the draftsman's desk, the stills and laboratories of the refinery, to the busy driveways of the service station—the petroleum industry stands eager and prepared to answer America's call . . . now, in peace, or in war. Yes, Mr. President, Mr. Congressmen—yes, America—we are ready."

The industry was urged by Dr. Wilson to increase its aviation-gasoline producing capacity within the next 18 months. Resistance of Britain to what Dr. Wilson said seemed almost overwhelming odds was possible because of superior quantity and quality of aviation gasoline. He reviewed the program of mechanization upon which the United States defense plan is predicated and again stressed the important role filled by the petroleum industry in the complete pattern.

Demand to date on the petroleum industry should not be accepted as typical of the enlarged defense requirements, Dr. Wilson warned. He repeated the first concern in the program was the production of machine tools needed to manufacture defense equipment in mass quantities. The real impact of petroleum demand will not be felt until American industry is tooled-up to make the planes, tanks, trucks, naval vessels and other equipment now on order.

Synthetic 100-Octane Fuel

"Coming to the specific refinery products," Dr. Wilson said, "the most probable bottleneck in our meeting the Army and Navy demands is also one of the most romantic stories of our industry, viz., synthetic 100-octane gasoline. Although the advantage of high-octane gasoline in making possible higher-compression engines has long been understood, the appreciation of its tremendous value for aviation purposes is somewhat more recent. In aviation, the more efficient high-compression engines have three advantages—first, a smaller fuel load; second, a lighter engine per horsepower; and third, less head resistance, due both to a smaller engine and a lower cooling load, because more heat is converted into work and less into heat to be rejected into the atmosphere. All of these mean higher speed and/or greater load-carrying ability, both of which are almost priceless for military purposes. For example, the difference of only 25 miles per hour in the top speed of two fighting planes gives the control of the attack or retreat to the faster plane."

The importance of building a stock pile now of aviation gasoline, Dr. Wilson pointed out, while we do have some surplus capacity seems obvious, and a substantial start in this direction has recently been made by the Army and Navy.

Referring to the desirability of increasing 100-octane-gasoline producing capacity, Dr. Wilson said he was hopeful that the industry would undertake such construction without government aid.

Failure to urge full operation of existing plants and cessation of diversion of synthetic products to regular motor fuel would constitute a dereliction of duty to both the industry and Government, Dr. Wilson said. Synthetic products, he said, may be used in producing 91-octane gasoline which may prove a bottleneck when the pilot-training program reaches full proportions in about a year from now.

The only deficiency of the industry in transportation visualized as a possibility by Dr. Wilson is in tanker capacity. The industry, he pointed out, will be called upon at an increasing rate to help eliminate the bottlenecks elsewhere, particularly in the manufacture of explosives and synthetic rubber.

Confirms Bright Forecast

Confirmation was given to the forecast elsewhere in this issue presaging another record demand for petroleum in 1941.

"To date," Dr. Wilson said, "the total buying of petroleum resulting from the defense program has been negligible—much less than enough to offset the loss of our exports to the continent of Europe. However, this demand is on its way. Not only will the Army and Navy have steadily increasing demands for almost every petroleum product, but there will also be additional industrial demands and demands from men who will have employment for the first time in many years. I estimate that by this coming spring these increasing demands will, on the whole, offset our loss of exports, and thereafter will increase steadily to a figure substantially beyond any total requirements the industy has yet seen."

Remarks of Dr. Wilson were closed with a plea for unity as the only means for overcoming the problems and task confronting the people of this nation.

As evidence of the industry's preparedness, Fred van Covern, director of the Institute's department of statistics, estimated that production of aviation gasoline has reached 45,000,000 gal. per month, far in excess of normal requirements. In addition, there are stocks on hand of nearly 240,000,000 gal., greatest in the country's history. Mr. van Covern said that the record consumption

T. H. BARTON
Lion Oil Refining Co., guest speaker

A. P. I. Features

This summary gives the reader a quick picture of proceedings at the twenty-first annual meeting of the American Petroleum Institute. As usual, this issue presents also several full-length technical papers presented at the meeting, these starting on Page 100.

An additional feature of this issue is a 10-page history and summary of the activities of the A.P.I., which starts on Page 89.

Editorial representatives of The Oil and Gas Journal who are attending the sessions at Chicago include C. O. Willson, W. T. Ziegenhain, H. F. Simons, and J. P. O'Donnell.

MARTIN DIES
Member of Congress, guest speaker

of aviation gasoline in 1939 was less than 0.5 of 1 per cent of all motor fuel consumed in this country.

"Effect of increased production of aviation fuels to be put into storage under expected defense orders on normal refining operations is uncertain. It is possible that 40 to 50 per cent will be base stocks from selected crude oils and the remainder a combination of high-octane blending agents. Manufacture of large quantities of aviation fuel might tend to reduce total yields of gasoline from crude oil and thus partly prevent piling up of abnormally high motor-fuel stocks next spring," Mr. van Covern declared.

The inability to see just where it is headed in the aviation-gasoline program is a strong influence in the interest manifested by the petroleum industry.

The advance of 15 cents per barrel in the posted price for Pennsylvania Grade crude oil made November 12 by South Penn Oil Co. was added to the other developments of the week to present a generally optimistic outlook. The Pennsylvania advance increased Bradford crude to $2 per barrel and terminated a series of four reductions starting last May 22.

Will Nullify Export Losses

It was generally conceded that the increase in motor-fuel demand next year would completely nullify the loss of export markets due to the war. This outlook has been repeatedly emphasized by Dr. Wilson, who came to Chicago from Washington to review the petroleum industry's ability to satisfy all conceivable demands that it may face in the defense program. Dr. Wilson reiterated the call that may be made upon the industry to help overcome bottle necks in other materials such as toluene and synthetic rubber.

The thousands of integral parts that combine to make up the petroleum industry were reexamined in the group sessions and committee meetings of the A.P.I. This review of multitudinous functions vital to the life and progress of the petroleum industry constitutes the nucleus of the Institute. The window dressing of general sessions and enouncements from directors serve a purpose, but the real vitality of the Institute is derived from the forum it provides in discussion of fundamental matters.

Each year there is a growing volume of technical knowledge to be reported and discussed at the divisional meetings and committee sessions and this meeting was no exception.

First committee sessions of the annual A.P.I. meeting started last Friday and extended through most of this week. The number of committee meetings is too great for individual listing here, but they covered discussions of practically every tool used by the industry.

Technicians Discuss Aviation Fuel

Production of aviation gasoline received only passing attention on the official program of the Refining Division, but naturally this subject was the most widely discussed by technicians from the manufacturing end of the industry. Through the papers presented there was found unmistakable evidence that a continuing interest will be devoted to greater production of high-octane gasoline.

The often-expressed belief that nothing much can be gained by going higher in octane number was entirely discounted by T. A. Boyd and W. G. Lovell, engineers from the research laboratories of General Motors Corp. at Detroit, Mich. Experimental data were revealed by these men showing that at 20 m.p.h. the use of 100-octane gasoline in an automobile engine resulted in an increase of 40 per cent in the miles-per-gallon performance. Supercharging, while not fully explored, appears to offer the method for overcoming the barrier of mechanical limitations on compression ratios.

The service requirements on gasoline and diesel engines are increasing rapidly and it is the duty of refiners and lubricating engineers to overcome some of the characteristics in crankcase oils which fall short of complete satisfaction. This conclusion was reached from a discussion of heavy-duty motor oils by H. C. Mougey, General Motors engineer. He listed four characteristics of an ideal lubricating oil: (1) It would not form undesirable deposits by thermal decomposition in the combustion chamber; (2) it would not contain objectionable amounts of easily oxidized sludge-forming materials; (3) it would not corrode bearings nor oxidize in the crankcase, forming corrosive acids or objectionable amounts of insoluble oxidation products; (4) it should have the property of preventing any soot or carbon or other decomposition products from sticking to the surfaces of the engine parts. This property is called "detergency."

Addition of 1 to 15 lb. of lecithin, a phosphatide obtained from soy beans, per 1,000 bbl. of gasoline improves the leaded and unleaded quality and stability. The results of tests under various conditions and with varied stocks were reviewed by H. V. Rees, W. S. Quimby, and J. C. D. Oosterhout, of the Texas Co., New York. Use of the product also decreased corrosion of storage-tank bottoms and reduced aluminum corrosion in aviation-gasoline tanks.

Development of synthetic gasolines is closely associated with the impressive list of chemicals now derived from petroleum gases. In addition to the well-known alcohols, ketones and esters produced from gases formerly used only as fuel, the industry now produces on laboratory, pilot-plant or commercial scale unsaturated alcohols and chlorides, glycerol and its derivatives, and butadiene. The review of synthetic chemicals derived from petroleum was presented by L. Rosenstein, of Shell Chemical Co., San Francisco, Calif.

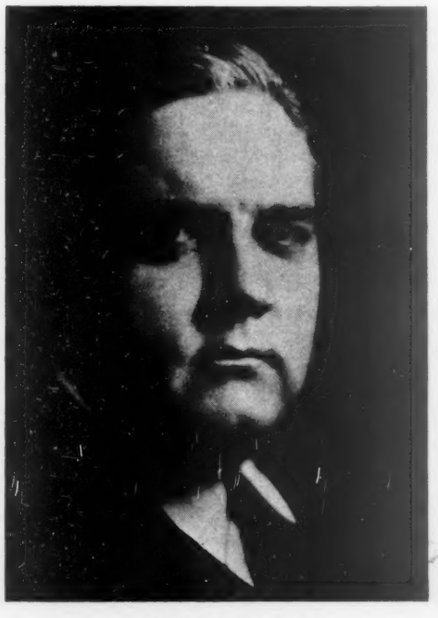
Water Emulsions

Utilization of water emulsions to effect continuous wax-oil separations was described by A. H. Schutte, engineer, the Lummus Co., New York. The processing time is a matter of minutes and, therefore, automatic control is immediately effective. Application of the process may be to the complete processing of slack wax to semirefined grades, or may be used as an adjunct to existing sweating equipment. Description was given of pilot-plant and commercial-scale results.

A decrease of 1.6 to 15.5 octane numbers in the motor fuel required for trouble-free operation was found obtainable by removal of combustion-chamber deposits. In a paper on "Fuel-Quality Requirements as Affected by Items of Motor Maintenance" the authors, H. M. Trimble and K. C. Bottenberg, Phillips Petroleum Co., Bartlesville, Okla., found also that carburetors determine the volatility characteristics of gasoline for trouble-free operation.

Improved performance of automobile engines with present-day fuels and a reduction in the

(Continued on Page 59)

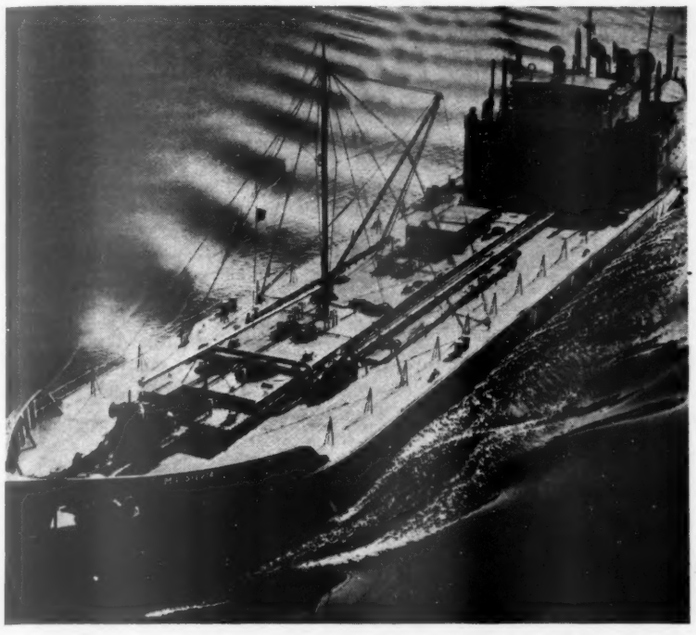


GEORGE A. HILL, JR.
Houston Oil Co., vice president for Production, A.P.I.

J. HOWARD PEW
Sun Oil Co., vice president for Refining, A.P.I.

ERIC V. WEBER
Eureka Oil Co., vice president for Marketing, A.P.I.

PETROLEUM INDUSTRY PHOTOGRAPHIC SALON

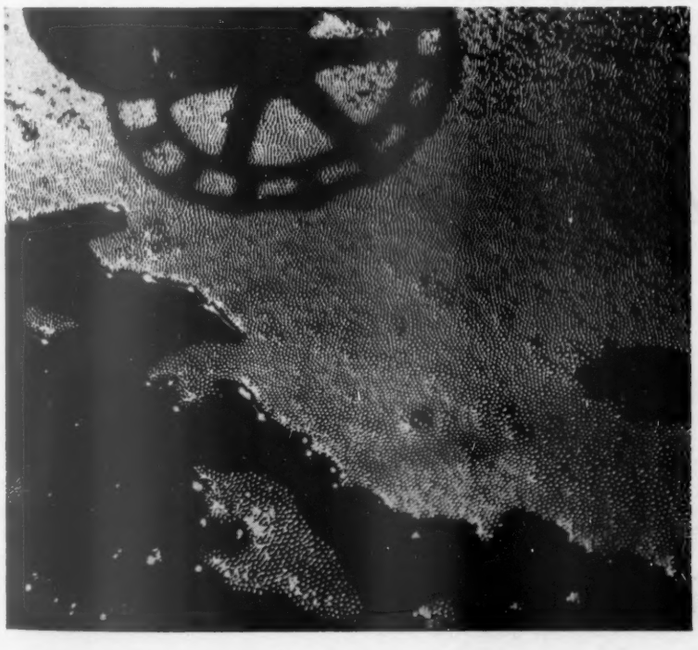


"AN OIL TANKER"

By Hiland Dale Holt, West Hartford, Conn., hung with first award

"OIL AND WATER"

By T. K. Shindo, Los Angeles, Calif., hung with second award

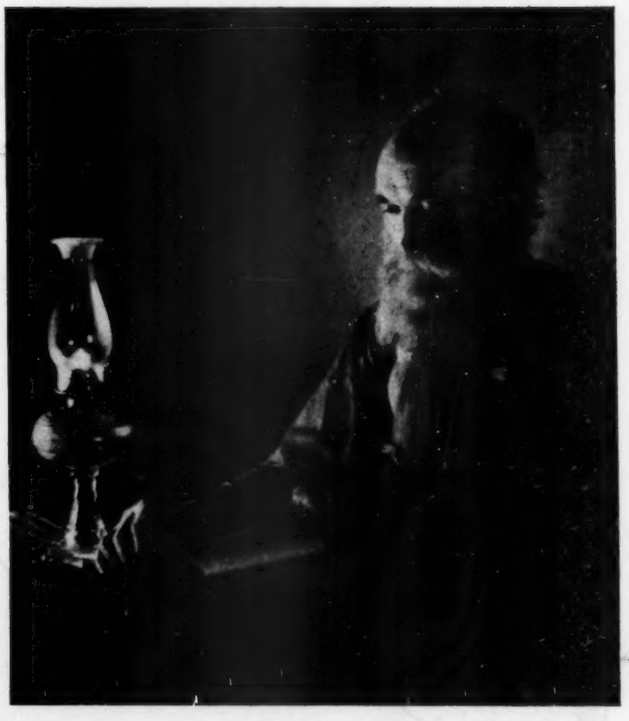


"CONTACT MAN"

By Joseph Russo, Dixon, Ill., hung with third award

"SAVANT"

By Charles Cox, Bloomingdale, Ohio, hung with fourth award



FOUR awards and 10 honors have been conferred by the awards judges for excellence of 14 among 193 photographs hung in the Petroleum Industry Photographic Salon at Chicago. Sponsored jointly by the Photographic Society of America and the American Petroleum Institute, the salon will be a feature of the Institute's twenty-first annual meeting. Photographers from all sections of the United States and Canada submitted pictures for the salon, first of a series planned as a means of encouraging the pictorial interpretation by the camera of modern life as reflected by business and industry.

Record Demand for Crude And Products in 1941

By J. P. O'DONNELL

ANOTHER year in which the demand for the oil industry's principal product, motor fuel, will set a new record is in prospect for 1941. An analysis of the major known factors which affect motor-fuel consumption indicates that the United States oil industry will be called upon to supply 647,000,000 bbl. of gasoline next year, an increase of 5.2 per cent from the indicated demand in 1940.

However, in view of the self-evident fact that runs to stills were excessive in 1940, that inventories of gasoline are now excessive and should be reduced and that supplies from sources other than crude oil will probably be larger than in this year, it is believed that runs to stills should show a much more modest increase. To meet the unexpected demand for gasoline and in consideration of the foregoing it is estimated that runs to stills of 1,320,000,000 bbl., a daily average of 3,625,000 bbl. will be required. This would be an increase of slightly less than 2.2 per cent over the indicated 1940 figure and would also set a new record for the industry.

The 1941 gasoline demand is expected to consist of 627,000,000 bbl. of domestic demand and 20,000,000 bbl. of exports, a gain of approximately 37,000,000 bbl. for the former and a decrease of 5,000,000 bbl. for the latter. The expected overall gain of 5.2 per cent may seem optimistic in view of the fact that the overall demand this year is expected to show a gain of but 3 per cent from 1939. However, the loss of exports accounted for the low overall increase this year and this factor probably will have been entirely overcome by increased domestic demand in 1941.

Actually domestic demand, on the basis of the indications of the first three quarters, will run 6.7 per cent greater this year than it did in 1939. In contrast with that percentage gain, the predicted domestic demand in 1941 is but 6.27 per cent above 1940, almost one-half of one per cent less than the actual gain this year. In addition the export loss will be proportoinately less severe for while the decline in exports this year is indicated at 42 per cent, the decline next year is expected to be about 20 per cent.

A comparison of the trends in demand for the 12 years up to and inciuding 1941 follows:

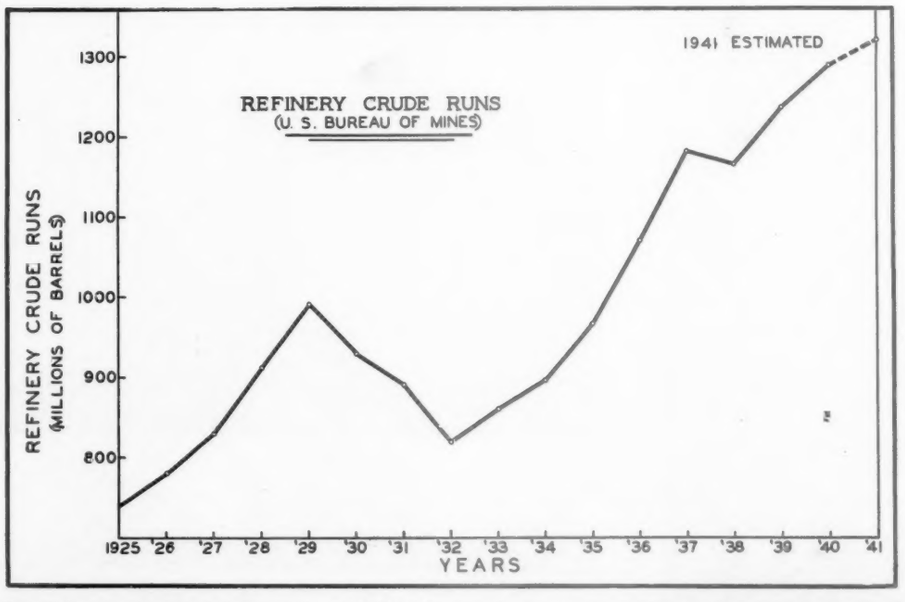
(Data in thousands of barrels)

Year	Domestic	Export	Total
1941	627,000	20,000	*647,000
1940	590,000	25,000	*615,000
1939	552,557	44,559	597,116
1938	523,003	50,109	573,112
1937	519,352	38,306	557,658
1936	481,606	28,646	510,252
1935	434,810	30,613	465,423
1934	410,339	24,686	435,025
1933	380,494	29,321	409,815
1932	377,791	35,438	413,229
1931	407,803	45,716	453,559
1930	397,609	65,575	463,184

*Estimated. Other data from U. S. Bureau of Mines.

Exports Will Be Reduced

Present indications are that the export demand this year will be approximately 25,000,000 bbl. and since some of foreign markets which were open in the first part of the year are now closed it is assumed that exports in the coming year will be less than in 1940. The matter of estimating exports of gasoline is difficult for they bear little relation to domestic demand and vary considerably in the course of a single year. During the past 20 years, for example, domestic demand with one exception showed an increase in each succeeding year whereas exports declined in 8 of those years. Another example of the irregularities in exports are those to Russia this year. They totaled 75,410 bbl. in January, were suspended until August when they were 150,693 bbl. and then rose in September to 333,477 bbl.



United States refiners will have to run 1,320,000 bbl. to stills in 1941 to satisfy the estimated demand (1940 and 1941 figures estimated by The Oil and Gas Journal)

Under normal conditions, approximately 89 per cent of the domestic consumption of gasoline is accounted for by motor vehicles so that any change in their status is reflected prominently in gasoline demand. Thus the principal factors affecting domestic consumption are the number of cars in use and the consumption of motor fuel per vehicle, each of which has risen with a fair degree of consistency over recent years and, it is indicated, will do so again in 1941.

One of the important keys to the number of vehicles in use is the record of motor-vehicle registration. With the exception of depression years, this record has shown a steady increase annually. For the year ended December 31, 1940, the estimated number of motor vehicle registrations is 32,375,000 compared with 30,615,087 at the beginning of the year, an increase of 5.7 per cent. Comparative figures on motor vehicle registrations for the past 5 years follow:

Year	Total	Per cent change
1940	*32,375,000	+5.7
1939	30,615,087	+3.8
1938	29,485,680	—0.7
1937	29,705,220	+5.5
1936	28,165,550	+7.3

*Estimated. Other data from Automobile Manufacturers Association.

Other factors to be considered in addition to motor-vehicle registration are new-car sales and the opinion was voiced at the recent New York automobile show that the 1941 model year would witness a 10 to 15 per cent gain. The scrapping of old cars which averages more than 2,400,000 per year and the number of unregistered government-owned vehicles which has been growing steadily. The consumption of motor fuel per vehicle in use is governed principally by economic conditions and the various indices of business activity provide an indication of how this factor will be affected. With the huge national-defense program due to be under way in earnest next year, it is certain that business activity will increase and that increase should be reflected in motor-fuel consumption per car. The trend of consumption per vehicle in use over the past 5 years is shown in the following table:

	Consumption (gal.)	Per cent change
1940	*740	+2.2
1939	724	+3.3
1938	701	—2.8
1937	721	+1.5
1936	710	+4.8

*Estimated. Other data from Automobile Manufacturers Association.

Increased Motor-Fuel Demand

All factors point to an increase in motor-fuel demand, an increase that will, as usual, be met principally by an increase in the production of gasoline from crude oil. In order to meet the anticipated 1941 demand, it has been estimated that runs to stills of 1,320,000,000 bbl. will be required, an increase of 2.17 per cent. The indicated 1941 total is 2.4 per cent over the indicated daily average for the current year which is one day longer.

Other sources of motor fuel supply will be natural gasoline, benzol and, possibly in part, storage withdrawals and imports. Imports have been a very minor consideration in recent years and this year only 79,000 bbl. were imported in the first 9 months, a small fraction of the 458,900,000 bbl. re-

quired to meet demand in that period. For all practical purposes, imports can be ignored.

With the prospect of there being more gasoline in storage as of March 31 than would be considered economical, it would be desirable for a part of the 1941 demand to be met from storage. It may be assumed that 7,000,000 bbl. of the demand next year will be met with gasoline from storage.

The other sources of motor-fuel supplies will be natural gasoline and benzol used as such and natural gasoline blended with gasoline from crude oil. It is estimated that the amount of natural gasoline and benzol used as such will supply 16,000,000 bbl. of the motor fuel demand next year and that natural gasoline blended at refineries, etc., will supply an additional 42,000,000 bbl. A combination of motor fuel from these two sources plus the indicated desirable withdrawals from storage would supply a total of 65,000,000 bbl. necessitating the production of 582,000,000 bbl. from crude oil.

The required amount of crude oil to meet this demand will depend on the yield of gasoline obtained. Assuming it to be 44 per cent, it would necessitate the processing of 1,320,000,000 bbl. of crude oil next year against an estimated total of 1,292,000,000 bbl. this year.

Increased Drilling Activity Is Seen for Mid-Continent

By W. V. HOWARD

DRILLING in the first 10 months of 1940 is running 15 per cent higher than during the corresponding period of 1939 due to the influence of three main factors. In surveying the prospects for 1941, it is necessary to consider whether these factors are still operating and whether additional factors will affect drilling during the next year.

Drilling in Kansas and North Texas has increased materially because of the feeling that with declining production in Illinois, there would be a greater demand for oil from these areas and, possibly, an increase in price. Both the decline in production and the increase in price in Illinois have taken place and further changes along the same line may be anticipated so that this cause of increased activity continues to operate.

The most important factor affecting drilling is lease and offset requirements, the latter of which increase with each discovery or extension.

Based on these factors, there appears to be no reason to expect any material change in drilling activity over the country as a whole during 1941. Individual areas will, however, experience fluctuations of considerable importance.

Appalachian Fields

Almost two-thirds of the increase in drilling activity over 1939 has taken place in the Appalachian fields. This was due to increases in price for Bradford crude during the latter part of 1939; and as prices have turned downward in this area, drilling has already begun to be curtailed. There has been some improvement in conditions as evidenced by this week's rise in crude prices.

The bright spot in the eastern picture is the increasing demand for gas. Not only in the Appalachian fields, but in Ohio as well, there is great activity in the search for gas. The Kanawha field of West Virginia is still active, but there is a steadily growing search for new fields. With gas bringing from 12 to 18 cents per 1,000 cu. ft., 3,000 to 4,000-ft. wells will pay out even on small production. The market is steadily growing and the supply diminishing. No lines are contemplated at present which would bring in western gas.

Middle Western Area

Following the drilling of several dry holes, the eastern Ohio deep-gas play has about died out, but a new deep-sand play is developing in eastern Kentucky. Activity would increase following any discovery in this region, but there is nothing yet in sight to cause any change. Drilling in Michigan has declined during the past year, and for a while it appeared as if the decline would continue owing to the lack of discoveries. However, during the past few months new fields have been opened up in Allegan, Arenac, and Gladwin counties; there have been encouraging showings in the Thumb district, and a new gas field in Osceola County has extended the productive area to the north of its former limits. The Bloomingdale field has also revived and these discoveries have increased the enthusiasm of Michigan operators to the point where they may again reach 1939 levels next year.

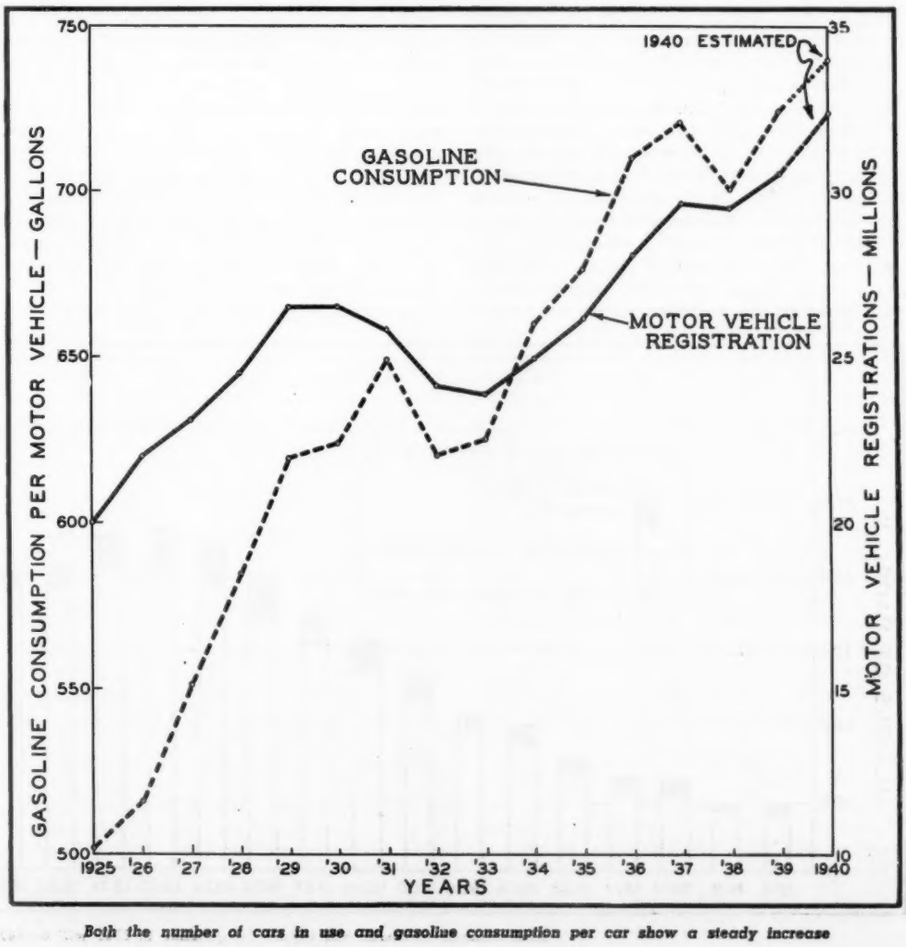
Indiana activity is up 30 per cent owing to drilling in the Griffin-New Harmony area. This district is nearly drilled up but a new discovery near Vincennes may maintain activity at present levels.

Illinois seems definitely slated for a decline. Salem, Louden, and Centralia are practically drilled up and no discoveries of comparable magnitude have been made for 2 years. The number of possible large fields is, of course, reduced by every dry hole, and there have been many. It appears as if Illinois will see a number of small pools which will be rapidly drilled up and total activity may run as much as 40 per cent below 1939 and the first 9 months of 1940. The finding of oil in the Trenton would probably start a boom similar to that in the Devonian last spring.

The northeastern area as a whole thus seems to be due for a reduction in activity of some 2,500 wells during 1941.

Forest City Basin and the Dakotas

The Forest City basin play is still very largely one of random wildcatting. Many operators have cooled off on the area. Thus, the situation is very similar to that in Illinois prior to the discovery of the Centralia, Louden, and Salem fields. It is unlikely that subsequent history will parallel that of Illinois, but there is no reason for believing that all of the oil in the area is concentrated in the southeast corner of Nebraska. Wildcatting will probably continue at present levels, although it will probably be close to present production. The Nebraska discoveries will also require offsets until the fields are drilled up so that there may be an increase in activity in the Forest City



Both the number of cars in use and gasoline consumption per car show a steady increase

basin, even though no additional discoveries are made.

At present, there is a lively lease play in North and South Dakota. Drilling will undoubtedly commence in the spring, but it is not likely that the activity will be very great during the next year unless a discovery is made by one of the early wildcats. Possibly 10 to 15 wells may be expected.

Kansas and Western Nebraska

Because of the large number of undrilled proven locations, Kansas will probably be even more active in 1941 than it has been this year. In fact, the increase of 50 per cent in drilling over last year may be repeated with the result that 2,400 completions may be considered possible. Kansas can be expected to benefit greatly from a continued decline in Illinois activity, particularly if it is accompanied by an increase in price. The new fields in Kansas are shallower than most recent discoveries, averaging between 3,000 and 4,000 ft., so that even with low allowables drilling is profitable.

Activity in Kansas is spreading out in two main directions, namely along the northwest-southeast Central Kansas uplift, and along a number of structural trends at right angles to this main arch. The main development has stopped at the north edge of Ellis County, but there are outpost fields in Rooks, Trego, Phillips, and Graham. Some of these will eventually prove to be large fields. Provided transportation facilities are furnished, this area should be active. As these fields are developed, wildcatting will extend farther to the northwest into western Nebraska.

In the more closely drilled portion of the Barton arch, there are two additional bases for more drilling. Very few of the fields are definitely outlined and production is gradually being extended with the merging of fields. This is taking place in the older pools, such as Silica, Trapp, Bemis, Gorham, Hall-Gurney and many others. In Ellsworth County, the Stoltenberg-Stratman-Wilkins area has had a revival of activity with the merging of these fields. This development is on the north flank of the arch and may encourage more activity along parallel trends. A second reason for activity is the fact that operators are twinning wells in search of deeper production. These wells, when successful, require offsets. Thus there appears to be no reason for a slackening in activity in the older and more developed portion of the arch.

Development of the crosstrends lags behind that of the main arch so that the one which is now receiving most attention is in Stafford County. The productivity of this area has been established by such pools as Zenith and there are a number of discoveries which will be centers of drilling activity next year. The Stafford County trend branches off from Wherry and Silica. Evidence exists of production on parallel trends branching off from Trapp and Bemis. There is no reason for believing that production will not continue to the southwest of Stafford County. The Lerado and Burrton trends have not been fully prospected. All of these facts argue for great activity in Kansas south of the Barton arch next year.

Hugoton will receive more development as additional demand for gas is made available by new pipe-line construction.

Oklahoma

Oklahoma's picture is not so clear as is that of Kansas. There appear to be no main trends waiting for prospecting. Southern Oklahoma has, of course, come into prominence as a result of the activity in Cumberland, Hewitt, and Montague counties, Texas. This district will undoubtedly receive a play which may develop into boom proportions.

The Seminole district is still active, with a number of extensions and discoveries which will maintain drilling in that area at approximately present levels. Okfuskee and Creek counties also are receiving attention as productive pimples are uncovered.

Farther to the northeast there has been a lull in drilling for water flooding, but with any encouragement in the form of increased prices secondary-recovery activity will be revived. Oklahoma's most recent major discoveries were along the Nemaha ridge which is of great importance from El Dorado to Oklahoma City. This ridge has been pretty thoroughly drilled up, but between it and the old Creek County area, there is a broad belt which is becoming more active, especially in Lincoln and Payne counties. Wilcox production is known to exist in this area in such pools as Ramsey and Laffoon. Gas is also being produced in greater quantities and activity will probably increase in this belt over the next year.

There has always been some scattered activity in western Oklahoma, and this has been revived to some extent during the past year. Successful wildcatting in Barber County, Kansas, in recent weeks may accelerate drilling in northwestern Oklahoma.

North Central Texas

The recent discoveries in Montague and Clay counties and the wildcat activity throughout the Fort Worth basin make an extension of drilling activity in North Texas very probable. This will be offset to some extent by completion of the development of the deep sand at K.M.A. Drilling in Hull-Silk should continue and there is a tendency to develop deeper sands in all of the old Cisco and Canyon fields. The result is that where North Texas was a 1,000-ft. area, recent drilling is between 3,000 and 5,000 ft., with possibilities of still deeper drilling into the Bend and Ordovician.

The West Central area is much less active, and a decrease in activity is expected, except in Jones County, where new fields are appearing with fair regularity.

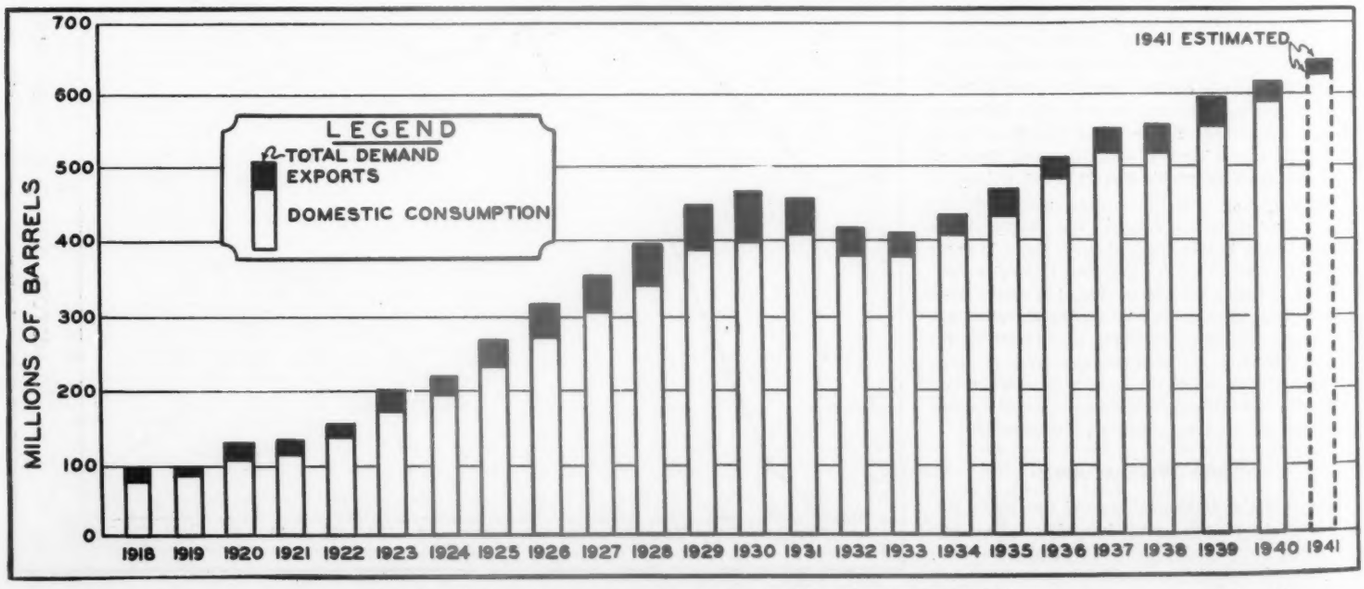
East and East Central Texas

Drilling in the East Texas field is approaching a minimum. It may vary from two to three wells a week to a dozen or more, depending on the liberality of the Railroad Commission in its interpretation of Rule 37. The remainder of the eastern area is less active than in 1939 and there is little reason apparent for much increase unless the Hawkins area should develop important production.

Arkansas-North Louisiana-East Texas Border

Activity in Arkansas has fallen off 25 per cent from 1939 owing to the drilling up of the Magnolia field. Prospects for 1941 are that the state's drilling will not be very much different from that of the present year. North Louisiana, on the other hand, has had a 25 per cent increase in activity owing to the development of Olla. There are now three additional fields in La Salle Parish to be drilled up and activity at Olla is increasing. Lisbon and Cotton Valley will probably also experience increased drilling to the deeper sands which have been discovered during the past few weeks. It is entirely possible that activity will increase over the area by another 25 per cent or to about 750 wells in 1941. This is not much greater than current drilling.

The East Texas border is quiet and, except for development of the Joaquin distillate and gas



Total demand (domestic and export) for gasoline in 1941 will be 647,000,000 bbl.

field, will probably remain so, although, naturally, a discovery will cause increased drilling.

Mississippi and Southeast

Drilling activity at Tinsley has slowed up as the field nears complete development, and there is nothing now in sight which will stimulate drilling next year. A great many wildcats have been drilled with, largely, disappointing results, but this drilling has demonstrated mainly that geological and geophysical data are insufficient to locate structures without slim-hole prospecting. This new development may easily result in the discovery of additional oil, especially as many wildcats have found encouraging shows not only in Mississippi but also in Alabama. All told, there appears to be no reason to believe that activity will decline to much below 150 wells in this area.

Texas and Louisiana Coastal Area

Coastal Louisiana has seen a definite increase in activity in 1940 and many fields have been discovered, as well as extensions and deeper sands in old fields. These newly discovered reserves are deep, 10,000-ft. wells being by no means uncommon. None of the new fields appear likely to precipitate a drilling boom, with the result that activity will probably continue through the coming year at about present levels.

The Texas Gulf Coast is less active than in 1939 and the only areas being rapidly drilled up are West Ranch and Lolita in Jackson County. This steady development will probably continue, so that both Louisiana and Texas Gulf Coast may have a total of 2,400 wells during the next year.

Southwest Texas is far more active because of shallower drilling and more diversified ownership. Wade City-Orange Grove, the Wilcox trend play in Jim Hogg and Starr counties, and the Mirando sand discovery in Webb County will probably keep drilling at only slightly lower levels than at present. The number of wells anticipated in 1941 is about 1,800.

Permian Basin and Panhandle

The Permian basin is potentially a very active district. Many fields have not been nearly completely drilled up and there are enough proven locations in Slaughter, Wasson, Goldsmith, McElroy and other fields to allow present activity to double during 1941. Low allowables and prices combine to restrict this drilling, and it is believed that next year's activity in the West Texas part of the basin will be not far from present levels, or about 1,750 wells.

Owing to extension of the Artesia group of fields, Eddy County, New Mexico, has become increasingly active of late, but Lea County has quieted down with the result that this year's drilling in southeastern New Mexico is at about the same level as last year's. This will probably continue through 1941.

In the Texas Panhandle drilling is up nearly 50 per cent over 1939. This is due to a growing demand for Panhandle oils as well as expiration of leases. Potentially, the Panhandle could absorb a great deal more drilling, but this will not develop under present marketing conditions. Next year's drilling will probably be about the same as this year's, namely 600 wells.

Rocky Mountain States

The Rocky Mountain states show an increase in activity over 1939 and it appears likely that this will continue. Cut Bank is being steadily drilled up and Kevin-Sunburst is also being pushed out by small extensions. This ensures a more or less uniform rate of drilling next year. In Wyoming, Lance Creek is almost drilled up, but Frannie, Cole Creek, and other fields will probably be drilled sufficiently to offset a decline here. Salt Creek is experiencing a deepening program, as is also La Barge. In Colorado, there is a prospect for an increase over this year owing to developments in Moffat, but this will probably not be large. Probably 450 wells will cover next year's total for the district.

California

This year California will have drilled about 950 wells. There have been few discoveries in California this year but the Del Valle-Castaic discovery will stimulate activity there. Declining production in the Los Angeles Basin will encourage wildcatting, especially, as a number of tests have been successful, as at Athens, Inglewood, and East Coyote. The Ford zone in Wilmington will probably not be drilled up, although it may be started by some operator with the result that over 100 new wells will be drilled there in a hurry. Tupman is good for another 50 or 60 next year. Considering the state as a whole, it seems probable that from 900 to 1,000 wells will be drilled.

Conclusions

With an anticipated increase in demand of 3½ per cent next year, it appears as though an unfavorable market trend in lubricating oils and the near completion of the Illinois drilling campaign will reduce drilling in the East by some 2,500 wells. To balance this, an increase of about 800 wells in Kansas, possibly 400 or 500 in North Texas, and 150 in North Louisiana appears reasonable. The remainder of the country appears likely to remain at present levels, with possible large increases in West Texas and the Panhandle if markets justify the increase. Average drilling so far this year has been at the rate of 595 wells per week while current activity is at about 580 wells. The decline in activity in Pennsylvania and Illinois has already become effective so that the average figure of 580 wells per week appears to be the reasonable expectation next year, barring of course a drilling boom following a major discovery which may take place at any time.

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Oil Industry Ready: Theme Of A. P. I. Sessions

(Continued from Page 54)

number of cases in which detonation is obtained with today's fuels was reported possible by correct spark timing. The conclusions reached by R. J. Greenshields and L. E. Hebl, Shell Oil Co., Inc., Wood River, Ill., were that the increase of 9 to 13 octane numbers to maintain maximum power at full load is not justified at the present time.

The Polyform process for producing high yields of motor fuels with C.F.R.-A.S.T.M. octanes from 70 to 80, described in detail in The Oil and Gas Journal, September 12, Page 52, was reviewed before the Refining Division. J. E. Bogk, Phillips Petroleum Co., Povl Ostergaard, Gulf Oil Corp., and E. R. Smoley, the Lummus Co., presented the paper. They told how the dilution of naphtha with propanes and butanes has a pronounced physical effect on reforming, permitting increased conversion per pass with less tendency to coking.

A new laboratory method of distillation which makes possible more exact separation of hydrocarbon fractions was described before one of the refining-division sessions. The process is called "azeotropic distillation" and the more minute separation possible, particularly of fractions having approximately the same boiling range, is of growing importance in chemical synthesis. Frederick D. Rossini, Beveridge J. Mair and Augustus Glasgow, Jr., National Bureau of Standards, prepared the paper. The process involves addition of a third substance which will alter the boiling points of both original substances and thus allow sharp separation.

Large quantities of oil have been conserved and more will be saved in the future by the growing knowledge of behavior within the reservoir. R. D. Wyckoff and M. Muskat, both of Gulf Research & Development Co., Pittsburgh, Pa., in two papers, reviewed and correlated the known data bearing on conditions in the oil sand itself.

Some phases of the fundamental research into the basic behavior patterns of the thousands of hydrocarbons which combine to make up crude oil, and which ultimately affect its recovery, were discussed by W. N. Lacey, of California Institute of Technology, Pasadena, Calif. The discussion, touching on multiple liquid phases in hydrocarbon solutions and particularly the separation of asphaltic material during production processes, was a partial interim report on the progress of the Institute's research project No. 37, directed by Dr. Lacey.

Corrosion-Test Program

Results of a 10-year soil-corrosion-test program were outlined by K. H. Logan, chief of the underground-corrosion section of the National Bureau of Standards. The important revelation was that the amount of protection afforded by many coatings was not uniform even under nominally the same conditions.

W. H. Carson, dean of the college of engineering, University of Oklahoma, Norman, Okla., and E. E. Ambrosius, associate professor, described the progress in research on oil meters. Report was made on the accuracy and durability of 10 types of meters.

Application of modern-instrument techniques to continuous drilling promises to make possible the more successful comletion of many wells, the production division was told by J. T. Hayward, Barnsdall Research Corp., Tulsa. Through the use of newly perfected instruments, Mr. Hayward related, minute traces of the character of the underground formations penetrated by the drill can be detected in the cuttings. Details were given on the mounting of instruments on trailers which can be moved from well to well and the application of test results were given by Mr. Hayward.

Other speakers at Thursday morning's session of the Production Division included W. W. Moore, Tulsa, who described the hydraulics of mud-circulating systems, and J. U. Teague, Hogg Oil Co., Houston, Tex., who spoke on "Economics of Controlling Water Produced with Oil." More economical drilling operations can be conducted when the actual hydraulics of this circulation are understood, Mr. Moore declared. In many wells, he said, the overall mechanical efficiency of the mud-circulating system can be improved materially and drilling costs lowered by a consideration of these factors.

Mr. Teague discussed the six major considerations involved in determining an oil-well producing program when water begins to encroach on the subterranean oil sand, including the alternative possibilities of treating the oil-water mixture underground and leaving it there, or bringing it to the surface with the oil and there making the separation.

An automatic fire extinguisher built into tank trucks, which may prove as revolutionary in the field of automotive transportation as was the sprinkler to commercial buildings, was explained to transportation experts by J. F. Winchester, Standard Oil Co. of New Jersey. The device, he said, is still in an experimental stage, but if it proves as successful as is now indicated it will be a boon to the industry.

SPARKS . . . FROM THE NEWS

THE ANSWER: A perusal of the technical and economic papers presented this week at the A.P.I. meeting is suggested for anyone who doubts that the petroleum industry is not fully prepared to do its part in this country's defense program.

IF: If the Texas Railroad Commission enforces its latest ruling canceling exemptions to shutdowns and special allowables cease the Lone Star situation will look better the last half of November.

DARK GLASS REMOVER: Assurance that the petroleum industry in this country will have a record demand for crude oil and practically all refinery products including many specialties in 1941 should cause many to remove their dark glasses.

MORE PLANES THAN CARS: An aviation enthusiast and designer of note predicted this week there would soon be as many planes in the United States as pleasure cars. He says manufacturers are working toward making an engine costing $100, weighing 100 lb., using 100-octane gasoline, and able to propel a plane at 100 m.p.h.

NO REST: Refiners who have lain awake nights for years figuring how they could keep abreast of the octane race will get little consolation from an A.P.I. paper explaining that the automobile industry wants still higher antiknock fuels than it now has.

GETTING READY: Although California's demand for natural gas is now supplied from the oil fields, a number of dry-gas fields are being developed for future use.

QUESTION: Substantial quantities of high-octane motor fuel have been shipped to the U.S.S.R. in recent months. The question now arises whether these shipments stopped there or continued on to Germany.

THREAT OR PROMISE: A current argument among oil operators is whether or not Secretary Ickes' resignation should be considered a threat or a promise.

SOME ENGINE: An air-cooled airplane engine is on the drafting board of a manufacturer which if built will develop 25,000 hp. This is five times the power consumed by any one of the larger streamlined trains.

REVALUATION: The Rumanian earthquake, implying a serious threat to Axis oil supplies, is a force over which dictators have no control and may seriously weaken their efforts looking toward world dominion.

AT LONG LAST: Government bureaus have finally agreed upon a storage goal of 3,000,000 bbl. of 100-octane gasoline by the end of 1941. The industry feels grateful for the decision even though the figure is 60 per cent less than originally talked.

NEW COST BASIS: A truck operator who has standardized on the use of diesel-engine power is suggesting the refining industry charge for oil on the ton-mile basis of service instead of the per-gallon basis. He says this will promote closer cooperation among the diesel-engine manufacturer, oil supplier, and the customer of both.

NEXT: Petroleum chemists report the manufacture of ammonia and other nitrogen compounds beginning with the cracking of natural gas. Another contribution to the defense program.

TAX THREAT: The oil industry has always been outstanding in opportunities for the small operator. The new federal-tax law is a threat to continuance of that desirable situation.

INNOVATION IN PIPE BENDING . . .

Unusual equipment has been devised for cold bending 12-in. pipe laid by the stovepiping method. This has been used by C. S. Foreman Co., contractor, laying a 9½-mile line with pipe furnished in 50-ft. joints, for a line for Lincoln Nebraska Gas Co. Diesel tractors on the job operate on fuel costing 14 cents per hour

Excess-Profits Tax Strikes Most At Medium-Sized Industries

By ROY F. GODFREY, C.P.A.
Warner & Godfrey, Tulsa

This analysis of the new excess-profits tax is designed especially to review the provisions inimical to the "middle" class in the oil industry. It is supplementary to a previous review in The Oil and Gas Journal, October 3, Page 22, which analyzed the excess-profits tax from a standpoint of the integrated companies upon which the adverse impact will be at a minimum.

Study of the excess-profits provisions of the Second Revenue Act reveals that medium-size companies in the oil industry will suffer the most under conditions of improved earnings.

THE purpose of this brief article is to set forth some of the more important provisions of the Second Revenue Act of 1940, which was signed by the president on October 8, 1940. This act includes seven titles, only two of which will be dealt with here. The remaining five titles include provision for special amortization of facilities necessary for national defense; provision for suspension of the Vinson-Trammell Act restricting profits upon the construction of naval vessels, etc.; provisions clarifying the law with respect to what constitutes earnings and profits of a corporation; provisions establishing a new system of insurance for persons in the active service of our land and naval forces; and provisions relating to credit against the federal unemployment tax by reason of late payments into a state unemployment fund.

Corporation Income Tax

Title 1 of the Second Revenue Act of 1940 amends Section 13(*b*) of the Internal Revenue Code so as to increase to 24 per cent the normal tax rate on corporations whose net income is in excess of $25,000 and is applicable to taxable years beginning after December 31, 1939.

While much of that which has been written and discussed to date concerning this new tax act has had to do with the computation of excess profits, profits credits, and the resulting taxes, it should be noted here that the increase in the normal income-tax rates of corporations for 1940 will apply whether or not any so-called excess-profits taxes will result. It means that every corporation earning over $25,000 will find a total per cent increase in its normal tax bill for 1940 of from 26 to 45 per cent over 1939, and the excess-profits tax may pile on top of that.

Excess-Profits Tax

The new excess-profits act of 1940 is likewise applicable only to taxable years beginning after December 31, 1939. Corporations whose fiscal year began in 1939 and ended in 1940 will not be called upon to reckon a tax under this act until after their fiscal year ending in 1941. This act is patterned to some extent after the excess-profits taxes which were in effect from 1917 to 1921. It is not to be confused with the excess-profits act which is a complement to the capital-stock tax and which is now designated "declared value excess-profits tax."

The tax is based upon the adjusted excess-profits net income in graduated brackets at the following rates:

Bracket—	Rate per cent
Up to $20,000	25
Next 30,000	30
Next 50,000	35
Next 150,000	40
Next 250,000	45
Over 500,000	50

Generally speaking, all corporations which are subject to the provisions of the income-tax law are also subject to the excess-profits tax, depending of course in the latter instance upon the existence of excess-profits net income.

Excess-Profits Net Income

In determining the amount of excess-profits net income, several possible adjustments must be taken into consideration after beginning with the amount of normal-tax net income. In this connection regard must be given to the method which may be employed in determining the excess-profits credit. If this credit is to be determined on the basis of the so-called income method, one set of adjustments must be used in arriving at the excess-profits net income of the current year. If the invested-capital method is used in determining the excess-profits credit, certain additional adjustments must be made to the normal-tax net income of the current year. The following adjustments shall be made to the normal-tax net income if the taxpayer uses the income method in determining its excess-profits credit:

Excess-Profit Credit

1. The regular normal income tax shall be deducted.

2. Long-term capital gains and losses shall be excluded.

3. Income from the discharge or retirement of bonds and other obligations shall be excluded.

4. AAA refunds and interest shall be excluded.

5. Bad-debt recoveries where the bad debt was allowable in any year prior to 1940 shall be excluded.

6. Credit for the full amount of dividends received on stock of domestic corporations shall be allowed.

In addition to the foregoing adjustments which are required under the income method, the following additional adjustments shall be made if the taxpayer uses the invested-capital method in determining its excess-profits credit:

1. If borrowed capital is used in the determination of invested capital, then only 50 per cent of the interest paid thereon during the current year shall be permitted as a deduction.

2. If the taxpayer has elected to treat government obligations as an admissible asset in its invested capital, it must report the full amount of interest thereon for excess-profits tax purposes.

All domestic corporations which were in existence prior to January 1, 1940, may elect to compute their excess-profits credit under (1) the income method, or (2) the invested-capital method. All other domestic corporations must use the invested-capital method. Provision is also made in the law to the effect that if a corporation does not file a timely return it must use the invested-capital method. Also, if it fails to designate which method it has elected to use the commissioner shall prescribe the invested-capital method for it.

Credit Based on Income

A corporation which elects to use this method is entitled to an excess-profits credit arrived at as follows:

(1) Ninety-five per cent of its average base-period net income; (2) plus 8 per cent of its net-capital additions; or (3) minus 6 per cent of its net-capital reductions.

The base-period years for corporations operating on a calendar year are the years 1936, 1937, 1938, and 1939. Technically, however, the base period comprises the taxable years beginning after December 31, 1935, and before January 1, 1940. In respect to each of the years in the base period, substantially similar adjustments must be made to the normal-tax net income of such years as are required to be made to the normal-tax net income of the current year. Certain other adjustments are of considerable importance:

1. Deduction is not required for losses resulting from fire, storm, shipwreck, or other casualty, or from demolition, abandonment or loss of useful value of property.

2. Claims, awards and judgments are not required to be deducted if such payments are abnormal in the light of the taxpayer's business, either by reason of their character or amount as compared with the four previous taxable years.

3. Intangible drilling and development costs in the case of oil or gas mines are not required as a deduction to the extent that they are abnormal in character or amount as compared with the four previous taxable years.

Method of Computation

After the normal-tax net income for each of the base-period years has been properly adjusted with respect to all of the factors provided in the act, certain of which have been referred to above, the result for each of the years is known as the excess-profits net income for such year. The average base-period net income for purposes of the excess-profits credit is determined by dividing the sum of the excess-profits net income for each of the base-period years by four. If one of the base-period years resulted in a loss, then the results for that year shall be stated at zero and the average base-period net income will be the sum of the three profitable base-years divided by four. If, however, more than one of the base years resulted in a loss, then the year of greatest loss shall be stated at zero and the loss of the other year or years shall be included in determining the average base-period net income.

If the corporation was not in existence during the entire 4 years of the base period, then for each year during which it was not in existence it shall be accorded a constructive excess-profits

net income equal to 8 per cent of the daily invested capital for the first day of its first taxable year beginning after December 31, 1939.

After the average base-period net income is arrived at along the lines above stated, 95 per cent thereof is taken as the starting point in arriving at the excess-profits credit. To this amount is added 8 per cent of the net capital additions during the current year. These additions include, among other things, money and property paid in for stock, or as paid-in surplus, or as contributions to capital. Conversely, if there have been net capital reductions during the year, 6 per cent thereof must be deducted in arriving at the excess-profits credit. Both the percentage of increase in respect of capital additions and the percentage of decrease in respect of capital reductions shall be figured on a daily basis to the extent applicable to the current year.

Credit Based on Invested Capital

If the taxpayer elects to use the invested-capital method in determining its excess-profits credit it will be entitled to a basic credit in an amount equal to 8 per cent of its invested capital for the taxable year. Invested capital is taken to mean the average invested capital of the corporation; that is, the aggregate of the daily invested capital for each day of the taxable year divided by the number of days in the taxable year (after due regard to the treatment of inadmissible assets). The commissioner is authorized to prescribe by regulations a method other than a daily basis, one that might be applied where the difference would not exceed $1,000.

Daily invested capital includes both equity invested capital and borrowed invested capital.

Generally speaking, equity invested capital includes the following:

1. Money previously paid in for stock, or as paid-in surplus, or as a contribution to capital.

2. Property previously paid in for stock or as paid-in surplus, or as a contribution to capital (at its proper basis).

3. Accumulated earnings and profits at the beginning of the taxable year.

The sum of the above items is to be reduced by:

1. Distributions in previous years not out of accumulated earnings and profits.

2. Distributions during the taxable year not out of earnings and profits of the taxable year.

Distribution Deductions

If a distribution is made during the first 60 days of the taxable year, it will generally be considered to have been made on the last day of the preceding taxable year and therefore will reduce the amount of the accumulated earnings and profits at the beginning of the year. This provision applies to taxable years beginning after December 31, 1940.

A taxpayer's invested capital, in addition to the foregoing items which comprise the so-called equity invested capital, may also include an amount resulting from its borrowed capital. The borrowed invested capital for any day of any taxable year is determined as of the beginning of that day and is an amount equal to 50 per cent of the corporation's borrowed capital for that day. Borrowed invested capital consists of the outstanding indebtedness of the corporation which is evidenced by a bond, note, bill of exchange, debenture, certificate of indebtedness, mortgage, or deed of trust. Due to provision in the act for the computation of daily invested capital, it follows that corporations with many changes in notes payable and other borrowed-capital accounts will have an extremely difficult task in preparing invested-capital schedules.

Previous reference has been made to the term inadmissible assets which means (1) stock in corporations, and (2) government obligations, any part of the interest from which is excludible from gross income. After all other adjustments are made the average adjusted capital must be reduced by a percentage thereof equal to the ratio of the total inadmissible assets to the total of all assets. The taxpayer may elect to treat all of its holdings of government obligations as admissible rather than inadmissible assets, thus increasing its excess-profits credit. But if it elects to do so, it must report the full amount of the interest for excess-profits-tax purposes although the interest remains exempt from the normal tax.

Adjusted Net Income

The rates of tax set forth in the early part of this article are applied to the adjusted excess-profits net income which is defined in the act as the excess-profits net income minus the sum of:

1. A specific exemption of $5,000.

2. The excess-profits-tax credit (determined under the income method, or the invested-capital method above described); and

3. In the case of normal-tax income for the taxable year of not more than $25,000 the excess of the excess-profits credit for the preceding year (if beginning after December 31, 1939) over the excess-profits net income for such year.

Abnormalities in Income

Section 721 of the act provides that if the income of the taxpayer is abnormal by reason of the inclusion therein of certain types of income mentioned below, then the commissioner is authorized to redetermine the amount of said income with the view of allocating some part thereof to preceding or future taxable years. Six classes of items which may have a bearing on producing abnormalities are set forth in the act as follows:

(*a*) Arising out of a claim, award, judgment, or decree, or interest on any of the foregoing; or

(*b*) Constituting an amount payable under a contract the performance of which required more than 12 months; or

(*c*) Resulting from exploration, discovery, prospecting, research, or development of tangible property, patents, formulas, or processes, or any combination of the foregoing, extending over a period of more than 12 months; or

(*d*) Includible in gross income for the taxable year rather than for a different taxable year by reason of a change in the taxpayer's accounting period or method of accounting; or

(*e*) In the case of a lessor of real property, amounts included in gross income for the taxable year by reason of the termination of the lease; or

(*f*) Dividends on stock of foreign corporations, except foreign personal holding companies.

Undoubtedly this section will give rise to many problems in the administration of the act.

Miscellaneous Provisions

With certain exceptions corporations in an affiliated group are permitted but not required to make a consolidated return for the purposes of the excess-profits tax. In this connection corporations are considered to be an affiliated group if connected through stock ownership with a common parent corporation which is one of the affiliated group, and (1) at least 95 per cent of each class of stock of each of the corporations except the common parent corporation is owned directly by one or more of the other corporations included in the group, and (2) the common parent corporation owns directly at least 95 per cent of each class of the stock of at least one of the other includible corporations.

Sections 740 to 752, inclusive, deal with the matter of computing the excess-profits credit of a taxpayer on the average-earning plan, the base-period experience of which includes assets acquired in certain types of so-called tax-free reorganizations. The provisions of these sections relating to corporations in this situation are extremely technical and involved, and would require more time and space to analyze than can be stated in this article.

It is not deemed practical at this early date to discuss any of the provisions of the act as they might particularly apply to the oil industry. Attention is called, however, to the section dealing with abnormalities in income in the taxable year and to the section dealing with the computation of the base-period earnings with particular reference to the matter of intangible drilling and development costs. Some relief may ultimately be afforded to certain corporations in the oil industry whose net income may be found to be abnormal in any particular year. Otherwise, it presently appears that corporations in the oil industry both large and small will feel the burden of this act.

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Pennsylvania Crude Market Hits Comeback Trail

OIL CITY, Pa., Nov. 12.—The Pennsylvania crude-oil market started its comeback November 12 when South Penn Oil Co. posted an advance of 15 cents per barrel for Bradford-Allegany, Southwest Pennsylvania and Eureka grades. The advance lifted Bradford-Allegany crude to $2; Southwest Pennsylvania to $1.65 and Eureka to $1.59 a barrel.

Even more significant than the 15-cent per barrel increase was that the advance interrupted a series of four consecutive reductions starting from $2.75 for Bradford crude on January 1, down to $2.50 on May 22, $2.25 on June 18, $2 on July 12, and $1.85 on August 28. Eureka crude dropped from $2.34 on January 1 to $2.09 on May 22, $1.84 on June 18, $1.59 on July 12, and $1.44 on August 28. Southwestern Pennsylvanian oil dropped from $2.40 on January 1 by the same stages to $1.50 on August 28.

The Pennsylvania crude market climbed rapidly during the final quarter of 1939 on the surge of export demand just after the war started. The decline of export trade was precipitous after the first quarter of this year causing the reductions totaling 90 cents.

In recent weeks the demand for gasoline and fuel oil has been brisk in western Pennsylvania. Movement of neutral oils has been satisfactory, but prices are unchanged.

Natural depletion of production in Illinois has eased the pressure from extraneous refining centers.

Cylinder oils have been in firm demand in recent weeks due to the expansion of activity in the heavy industrial plants.

The OIL AND GAS JOURNAL

PRODUCING REFINING NATURAL GASOLINE PIPE LINE

Published weekly by The Petroleum Publishing Company at Tulsa, Oklahoma

As Regards Outlook

What about 1941?

The answer to this question will be uppermost in the minds of hundreds from all parts of the country and many foreign lands as they meet in Chicago this week.

Those whose outlook may have been darkened by recent developments both within and outside the industry should give consideration to the most vital statistics of the business of which they are a part.

While operators including those who serve them naturally center their attention on day-to-day production reports, economists are more concerned with the long-range consumption trends. If they can see a continuing demand for the industry's products they know that any current indispositions can be quickly remedied.

As to the coming year, another record demand for crude oil and refinery products is assured.

The only "ifs" have to do with how large this increase will be and these in turn are largely dependent on war developments. While it is not feasible to project the European hostilities in relation to oil purchases, increases in export demands from this country next year are more probable than further decreases.

Every major change in war fronts so far has restricted oil markets. Conquered peoples are existing on a small fraction of their needs, belligerents have restricted civilian use and the neighboring neutrals, fearful as to the future, are conserving their limited supplies.

This situation cannot continue indefinitely. People at war or at peace must have petroleum and its availability in the Eastern Hemisphere may shortly determine the final outcome of the war. In the meanwhile any losses in world oil markets are certain to be temporary.

Fortunately, the course of the oil industry in this country next year as in the past will be largely determined by conditions within its own borders.

While Europe has seen its petroleum markets contract, demands in the United States and the Western Hemisphere generally have expanded. So far as this country is concerned, its domestic gains have greatly exceeded the export losses and a continuance of that condition is in prospect for the coming year.

The record number of motor vehicles which will be in operation at the close of this year and the new-car production schedule for the following 12 months point to a domestic gasoline demand in 1941 of more than 625,000,000 bbl., representing a 50 per cent gain over 10 years ago.

Gasoline exports will bring the total motor-fuel requirements next year to approximately 650 million barrels, a gain of 5 per cent over the record-breaking year now closing.

This assured demand for gasoline and other products is in no sense a defense-program market.

It is a continuance of trends of the past based on peacetime activities which have brought the petroleum industry more and more outlets with a larger per capita consumption by old and new customers.

While growth in motor-fuel consumption is outstanding, consumer needs of practically all of the principal fractions of a barrel of crude oil are greater. To these can be added the ever-growing petroleum chemical industry which will shortly become a major enterprise.

A 5 per cent gain in gasoline requirements does not of course mean similar increases in demand for all other products and crude oil. Right now there is the necessity of adjusting operations in order to liquidate excess inventory positions brought about by operators who insisted on overproducing this year's highly satisfactory requirements.

Most of these adjustments can be made over the remainder of the year and the industry made ready for the profitable handling of 1941's 1½-billion-barrel market.

STATE CAPITALS...

TEXAS

EXCLUSIVE OF EXEMPTIONS GRANTED the Cayuga and Eureka Heights fields, the Railroad Commission on Saturday calculated the exemption order it issued on November 4 had effected a reduction of 122,978 bbl. in the state's daily average allowable over the whole month as compared to the average of the previous week. The commission's Oil and Gas Division estimated the net average was cut from 1,424,025 to 1,301,047 bbl. The latter was 10,049 bbl. over the market-demand estimate of the Bureau of Mines. However, deduction of underproduction of allowables, estimated at 3 per cent, would place the actual flow 28,984 bbl. under the bureau's forecast. In September, underproduction of the allowable amounted to 4 per cent, the commission has reported.

All of the reduction was effected in the lowering of exempt production, which dropped from 207,442 to 74,108 bbl. daily average. The basic allowable rose 14,796 to 1,752,772 bbl.

Every proration district except East Texas registered drops. A 31,651 bbl. cut in Southwest Texas, to a daily average of 206,688 bbl. was the largest reduction. East Texas remained unchanged at a daily average of 366,909 bbl., as it had not been exempt from the 9 shutdown days this month. Daily average allowables for other districts and the change from the previous week were, in barrels: Gulf Coast 223,995, down 15,228; East Central 74,217, down 6,298; West Central 50,487, down 4,654; West Texas 200,039, down 22,960; North Texas 115,977, down 18,056, and Panhandle 62,735, down 24,130.

THE CAYUGA FIELD in Anderson County, which produces an asphalt yielding crude, was relieved of shutdown requirements as Chairman Lon A. Smith signed an order recommended by Commissioner E. O. Thompson. The exemption will restore about 3,600 bbl. daily average production, giving it a daily output of 12,150 bbl.

Also exempt from shutdowns the remainder of this month was the Eureka Heights field in Harris County on order of Commissioners Smith and Thompson to provide crude for operation of Crown Central Petroleum Co.'s Houston refinery, which had only 2 days' supply on hand. Without an exemption, the field would have been required to close Saturday and Sunday, as well as 5 more days this month. The exemption will permit daily production of about 2,225 bbl. Application of shutdowns would have reduced it by about 670 bbl. daily. The crude, which yields only 15 per cent gasoline, is in strong demand for heating oil.

Granting of the exemptions, along with prior ones for the asphalt-base crude oils of Talco and Sulphur Bluff, reflected an apparent policy of the commission to permit the running of sufficient crude to meet firm, nonstorage demand while attempting to hold the state's overall flow down so excessive stocks will not be built up. The order of November 4, which revoked exemptions for all fields except those with extremely difficult operating conditions, was entered as statistics indicated a sharp upturn in crude storage the preceding week.

FINAL JUDGMENT RESTRAINING 11 companies from polluting the Neches River drainage system with water produced from East Texas oil wells was entered last week for Atty. Gen. Gerald Mann and the state District Court Judge John A. Rawlins. A motion for a new trial was overruled by Judge Rawlins, and attorneys for the defendants filed notice of appeal to the Fifth Court of Civil Appeals.

The order restrains the defendants from pumping salt water directly or indirectly into natural water streams, or using evaporation pits that allow the mineral waste to seep through the ground and into underground water supplies. Defendants against whom the injunction was obtained include Overton Refining Co., R. H. Vice, Alex McCutchin, C. K. West, Constantin & Co., Thompson Bros. & Ogden, H. W. Donnell, M. H. McMurrey, the McCurrey Corp., Goldsmith & Powell and John F. Merrick.

Asst. Atty. Gen. Hugh Q. Buck, who handled the case for the state, has indicated that an injunction may be sought against 20 other East Texas oil companies allegedly violating the terms of an agreement to halt pollution. Originally 150 companies were named in the suit.

ATTY. GEN. GERALD C. MANN has advised the Railroad Commission that Houston Natural Gas Corp. had lost its right of appeal to the commission in a rate matter by reason of delay. The opinion answered an inquiry of Commissioners Lon A. Smith and Jerry Sadler regarding a proposed appeal from a gas-rate ordinance of El Campo, Tex., effective September 1, 1939.

OKLAHOMA

STREAMLINING OF THE CORPORATION COMmission to weed out inefficiency and to abolish "political patronage" was promised Saturday by William J. Armstrong, chief conservation officer, who has been elected to succeed A. S. J. Shaw as a member of the commission in January.

"The two members of the commission with whom I will work, are in complete sympathy with this program," Mr. Armstrong said in a prepared statement. "I have received repeated assurance from Chairman Bond and Commissioner Weems of their cooperation in the attainment of these ends. In fact, they gave me this assurance early in the campaign. Without their promise of cooperation in bringing about these needed reforms and retrenchment in expenditures, I would not have been a candidate."

Costs of operating the commission can be reduced to effect its share in balancing the state budget, Mr. Armstrong said, and "this without the slightest sacrifice of efficiency." Work of the commission, perhaps more so than any other department of state government, is of highly specialized and technical nature, Mr. Armstrong explained. In key positions or as department heads there are needed accountants, lawyers, chemists, civil engineers, gas, electric and telephone engineers; railroad-rate and traffic experts, experts in regulation of the motor industry and men of experience in the oil industry, he said.

WALTER H. VOSKUIL

The existence of a mineral deposit does not necessarily mean that it will be developed. Almost as important are the economic factors which determine whether or not economic exploitation is possible. The mineral industries of Illinois are fortunate in having available the services of an able mineral economist, Walter H. Voskuil, who is on the staff of the Illinois State Geological Survey at Urbana

CALIFORNIA

THE AMENDED NYE BILL now pending in Congress and which may soon result in definite action is causing considerable anxiety and unrest in the California oil industry. The scope of this bill is so broad in its present form that the federal Government can claim all submerged or reclaimed land in harbors, rivers and lakes as well as tidelands adjacent to and beneath the ocean waters. Obviously any such bill is of vital importance to the State of California, the cities of Long Beach and Huntington Beach and innumerable operators and property owners. In addition to affecting title to the lands in question the impending suit or claim will be drawn with the idea of recovering any and all revenues derived from such property. This will be particularly true if the federal Government proceeds with its intention of attacking original titles. This means that all property not previously held under actual and specific Spanish or Mexican grants became public domain upon signature of the treaty of Guadalupe Hidalgo. Congress, it will be claimed, has exclusive jurisdiction over the public domain and it will be held that if it has not granted title it still retains title. Obviously this suit will affect considerable acreage and areas and districts remote from the present sphere.

There is no reason why the provisions of this bill should not apply to San Francisco and the San Francisco Bay region as well as to Los Angeles and Long Beach harbors as all three districts contain reclaimed land. The entire water front of San Francisco and for several blocks up Market Street, a main thoroughfare, is filled-in and reclaimed land. At Los Angeles Harbor as well as in the Long Beach Harbor area there is considerable reclaimed land, the reclamation having been accomplished by dredging operations in the various ship channels as the debris and earth dredged recovered the swamp land. Operators who have spent millions of dollars in development work are fearful of an unfavorable decision and the State of California as well as the cities of Long Beach and Huntington Beach will not only lose title but will be forced to recompense the federal Government for any and all revenues received to date. The statute of limitations does not run in a case of this kind or against the federal Government. The impending claim of the federal Government will vitally affect acreage in the Wilmington, Huntington Beach, Rincon and Elwood oil fields and the Rio Vista gas field. The claim might also affect production in the Buena Vista gas field and in nearby oil fields depending upon what line is accepted as the old water mark of Buena Vista Lake.

KANSAS

POTENTIAL TESTS will be taken of all wells in the Silica pool of Barton and Rice counties commencing November 14, Theo A. Morgan, conservation director of the Kansas Corporation Commission, has announced. Affected will be 543 oil wells producing from the Arbuckle dolomite, and eight oil wells in the Lansing-Kansas City lime series.

Industry Facing A State of Flux With Return of Administration

By HENRY D. RALPH

WASHINGTON, D. C., Nov. 11.—Further changes in the relationship between the federal Government and business, including the oil industry, are presaged by the verdict of the majority of the voters in decreeing another 4 years of the New Deal.

The vote which gave President Roosevelt his unprecedented third terms in the White House and strengthened Democratic control of the House is looked upon by the New Dealers as a clear mandate to continue the "Roosevelt Revolution" and to press ahead with the program of social reform, business regulation, and centralization of power in the federal Government. The fact that the president's popular majority is less than it was 4 years ago, and the growing movement for national unity and abandonment of partisan strife, do not mean that the New Deal will be mellowed and moderated or that there will be a "breathing spell" before more social reform.

On the contrary, it is the studied conviction of most Washington observers that the president and his close circle of advisers have both the inclination and the opportunity to clinch the social progress already made and to expand it into new fields. President Roosevelt is under no obligation to any group or individual for his reelection. It was a personal victory for him, and he can dictate the course of his party as he pleases, at least during the next 2 years. It is traditional that a president has little difficulty with a newly elected congressional majority of his own party, and the new Congress is expected to be particularly subservient, not only because of the defense crisis and the fact that so many members of Congress owe their seats to the surge of votes which retained the president. After a year or so there may be a swing in popular sentiment which would be reflected in Congress, and as the time for state primaries approaches there may be a rebellion in Congress, but for the next year at least Congress will be quite subservient to the wishes of the White House.

Will Strike While Iron Is Hot

Quite aware of this situation, the New Dealers plan to strike while the iron is hot and expand their program as rapidly as possible. The fact that major attention is centered on the defense program and on foreign affairs will not prevent development of the domestic program, but instead the defense program can become the means of putting through new social reforms which otherwise might meet violent objection.

The first confirmation of this is the announcement of Secretary of the Treasury Morganthau that he will ask Congress to raise the national-debt limit to 65 billion dollars. Since the present defense program will be crowding the existing limit of 49 billion dollars some time next spring, it is obvious that the debt limit will have to be raised in any event, but the assumption was that the limit would be raised only a little at a time as defense requirements actually dictated. Such a huge increase in the debt limit is interpreted as meaning that the New Deal is preparing to revive its spend-lend proposal and is still convinced that heavy government spending will bring back prosperity. It also suggests there is no intention of economizing on other government activities in order to divert funds to defense.

The fear of inflation caused by the prospects of the debt increase and heavier spending, plus the defense procurement program, is having a tendency to stiffen commodity prices, and government officials are watching this trend most closely. High prices and the high wages which would go with them would greatly hinder the defense program and would cause other dislocations in the economic structure, and the administration is determined not to permit an upward spiral of prices. For this reason observers are expecting a move for legislation giving the Government some power to control prices, perhaps after the pattern of World War legislation.

T.N.E.C. To Be Expanded

The urge for national economic planning will show itself in other ways. The Temporary National Economic Committee is expected to take on new life, and the New Dealers hope to make this a permanent organization composed of members of executive agencies and without congressional representation. A large number of reports, staff studies and monographs prepared by the T.N.E.C. have been withheld from release during the political campaign and are now coming off the press, and some of these will be found to contain drastic suggestions for federal regulation of business. The radical suggestions which centered in the T.N.E.C. when it was formed have been soft-pedaled by the congressional members to date, but there is a reason to believe that they will be revived by the New Dealers and that many of them will be put into effect.

Under the plea of national-defense requirements, the administration may move to control the flow of investment into industry by regulating the building of factories and new equipment. A minor step in this direction has already been taken in the priorities board of the Defense Commission which has the power to prevent nondefense industries from getting machine tools, steel, building materials, and other supplies if it appears that these things are urgently needed by defense contractors. Observers recall that during the early days of the New Deal there was much talk about the need for preventing industry from expanding productive facilities too fast or from concentrating in certain localities, and this idea is cropping up again as a possible defense measure.

Expanded social benefits are high up on the program of new measures. The social security system will be altered to increase certain classes of benefit payments and to extend these benefits to large groups of persons now outside the system. Bills to accomplish this were drafted months ago and they will be pushed in the next session of Congress. Social security taxes probably will not be increased, but the larger payments will prevent piling up a reserve fund.

Prospects for modification of the labor-relations and wage-hour law are very slim now. The faction of the C.I.O. which has split with John L. Lewis is boasting about the defeat of several members of Congress who advocated such changes. One of the first objectives of the administration is to bring about peace between the opposing groups of labor unions, and if this can be accomplished and labor made to present a united front, labor legislation may be extended instead of modified, though industry should benefit through relief from organization efforts of rival unions.

New Taxes in Prospect

New taxes will be proposed early in the next session. Not only is more money required to run the federal Government, but the Treasury is not satisfied with many provisions of the two revenue laws passed this summer. New Dealers feel that Congress was too easy on business in these laws, and that they should be revised along the lines of early New Deal tax laws to permit some degree of business control through taxation. The most probable change will be sharply graduated corporation taxes in order to put heavier burdens on the larger firms on the theory that business bigness is a social evil and that taxation should be a means of distributing national wealth. Revision of oil and gas-depletion allowances undoubtedly will be attempted again.

The trust-busting drive of Thurman Arnold naturally will be continued in full force, and in addition the Department of Justice is planning to operate in other ways to attempt to reform economic structure and practice. It is working closely with the T.N.E.C. to this end, and right now it is taking a great interest in the relationships between American business concerns and foreign interests, particularly German. The department is doing the spade work for Senator Wheeler's forthcoming investigation of the defense program and of foreign connections of American industry, and promises some exciting disclosures when hearings begin in January.

A plea for national unity is growing throughout the country, a desire to forget the bitterness of the political campaign and to concentrate attention on preparedness. The final stand of Republicans toward this movement has not yet crystallized, but it appears now that they will join in it to the extent necessary to promote the defense program but will keep on the alert to prevent the administration from using the unity movement, the defense program or the foreign crisis as a cloak to cover another social revolution which would carry over into normal times. In spite of this, observers are convinced that the New Deal will be able to go a long way in the next year toward putting into effect many forms of business regulation which have been stymied during the last 2 years.

Jersey Standard Defines The Gasoline Situation

THE oil industry could be excused for feeling that one of its worst problems had been agreeably solved if this were April 1.

Refiners would be entering the main consuming season with the hope that their working stocks of motor fuel, while small, might not be out of line with summer demands. They would have an assured supply of crude oil sufficient to meet the rising demand common to that period of the year but the current producing rate would not be high enough to stimulate refineries to a scale of operations in excess of consumer needs.

Unfortunately, this is not spring but only late fall. And stocks which would not be excessive in April are burdensome today. The inventory situation should be faced frankly. Not only has the industry a good deal too much motor fuel on its hands but it is not expected to do anything to keep the picture from becoming worse before the start of the main gasoline-consuming season in the spring.

Motor-fuel stocks on October 26 were 80.9 million barrels. While some further withdrawals may take place, stocks are pretty nearly as low as they will go in 1940. Based on the total estimated gasoline demand for the current year they represent 49 days' supply.

To get a picture of just how excessive present motor-fuel inventories are, let us strike an average of various estimates of adequate minimum working levels for the industry's principal product. Such a figure would be in the neighborhood of 65 million barrels, or a little less than 39 days' supply. In other words, the oil man has in storage at least 15 million barrels more gasoline than he needs at this time of year.

Refinery Runs Speeded Up

Back in 1935 the industry had what was regarded as generous stocks of finished and unfinished gasoline when the October 31 figure stood at 50 million barrels. Nevertheless, it added 8 million barrels the following year and another 10 million barrels in 1937, bringing the total up to 68 million. It slowed down then and increased the stocks by only 1 million in 1938. However, refinery runs were speeded up to lift the stocks above 73 million a year ago and they have been enlarged another 8 million since.

Even making allowance for the fact that consumption has increased and that if the above figures were given in terms of the number of days' supply on hand the growth would be less startling, it is obvious to everybody that the industry has filled up its storage too rapidly. The present surplus points definitely to the advisability of reducing refinery activity for the production of motor gasoline.

To its fall inventories of motor fuel the industry has in former years added something like 24 million barrels during the winter. So that if the next few months repeat past performance there will be more than 100 million barrels cramming gasoline storage facilities by the first of next April.

Three factors combined to put the industry in this hole:

1. *Exports.* — Many refiners overestimated the probable war demand, or failed to consider the offsetting loss of civilian markets in belligerent countries, in planning their operations last fall. With the collapse of France and the ensuing blockade of continental Europe and part of Africa, gasoline exports for the first 9 months of this year were off 48 per cent from the corresponding period of 1939. On the Gulf and Atlantic seaboard motor-fuel exports dropped 55 per cent.

2. *The weather.* — The prolonged cold spell of last winter put an unusually heavy demand for heating oil on the refining industry. Lacking sufficient stocks, many refiners found no way of meeting this call on short notice except to run more crude and thus of necessity to pile up additional gasoline stocks.

3. *Illinois.*—Lacking any proration restrictions, production in Illinois mounted rapidly during the first half of the current year and reached its peak during the early summer. Illinois crude went to market irrespective of demand and the pressure of this overproduction, as it always does, had its effect on gasoline inventories, which reached an all-time high of 103.7 million barrels on April 1.

From the foregoing it is not surprising to find crude-oil stocks appreciably higher than a year ago, when they were close to minimum working levels. On September 30 last, crude inventories stood at 274 million barrels, about 10 per cent above the figure for the same date in 1939.

Fortunately, the industry's overall outlook is by no means as gloomy as the inventory situation taken by itself would seem to indicate. There are at least three factors which justify a more optimistic look ahead:

1. Domestic demand for motor fuel is holding up well despite the serious loss of export markets. The present outlook is that the 1940 gasoline consumption, both domestic and export, will be in the neighborhood of 611 million barrels, an increase of 2 per cent over last year.

2. There is a growing realization among refiners that by proper adjustment of crude runs it is quite possible to supply an expanded market for fuel and heating oils during the winter without adding unnecessarily to gasoline storage. This is reflected in an increase in the yield of gas oil and distillate fuel of from 12.93 per cent during the first 9 months of 1939 to 14.14 per cent in the same period this year. Last winter the industry demonstrated its ability to obtain yields as high as 15.98 per cent.

3. Another factor making for a brighter outlook is that the refiner is going into the heating season with appreciably higher stocks of gas oil and distillate fuel than last year. On September 30 this increase in inventories amounted to 25 per cent, which should be sufficient to take care of any unforeseen increase from abnormally cold weather without any increase of crude runs.

At first glance an increase of only 1.21 per cent in the average yield of heating oil from a barrel of crude may not appear to be of much importance. But when you consider that even a 1 per cent increase in the yield of gas oil and distillate on the total crude run corresponds to 13 million barrels additional annual production of these products, the figure begins to mean something. Put in another way, the industry could take care of an increase of 7 per cent in annual demand for gas oil and distillate without adding a single extra gallon of gasoline to storage.

In fact, by increasing the percentage of gas oil and distillate recovered from the crude during the ensuing winter months, it is even possible to reduce appreciably the quantity of motor fuel which otherwise would be piled onto the present already topheavy stocks. So, if the gasoline inventory situation today provides little cause for optimism, the industry at least has a partial solution of the problem in its own hands.

The articles on this page, which will appear in a forthcoming issue of The Lamp, official organ of the Standard Oil Co. of New Jersey, discuss current conditions with regard to gasoline stocks and sources of crude-oil supply.

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Shifting Crude Stream

THE sources from which crude oil is obtained in the United States shift about from time to time in a bewildering fashion. Within the memory of living men the principal source of crude oil in this country has moved successively from the western slope of the Alleghenies to the Pacific Coast, to the Mid-Continent and, finally, to the coastal plain of the Gulf of Mexico.

The history of oil production in the State of Illinois illustrates typical vagaries of this shifting crude stream. Oil in commercial quantities was first discovered in Illinois in 1906.* In step with the common oil-production methods of those early days, Illinois operators drilled their wells posthaste and flowed them wide open. The result was that Illinois production gushed violently upward, reaching its peak within 2 years (92,000 bbl. daily average for the year 1908). Thereafter, as the flow ceased and the wells were put on the pump, Illinois production gradually declined to insignificant proportions.

But early in 1937, after the old wells had all but ceased to produce, Illinois again came to the fore with the discovery of important new oil fields, and again there followed a period of frenzied development and wide-open flow. Production rose from an average of 11,000 bbl. daily in 1937 to 66,000 bbl. daily in 1938, and to 258,000 bbl. daily in 1939. By the middle of 1940 the state's flow had reached a peak of 518,000 bbl. per day.

Immediately thereafter the precipitate decline that inevitably follows upon wide-open flow of oil fields manifested itself and Illinois' stature as an oil-producing state began rapidly to dwindle. Within 2 months the production had gone off to 378,000 bbl. a day, a decline of 30 per cent. This performance is reminiscent of the famous Ranger field in Texas, developed shortly after the close of the World War, which produced 90 per cent

(Continued on Page 257)

*The first recorded discovery of oil in Illinois dates back to 1889. Not until 1906, however, did the annual production for the state amount to as much as 1,000,000 bbl.

Pacific Section Of A.A.P.G. and S.E.P.M. Meet In Los Angeles

FRANK S. HUDSON
Elected president Pacific A.A.P.G.

E. J. BARTOSH
Reelected secretary-treasurer

By L. P. STOCKMAN

LOS ANGELES, Calif., Nov. 12.—The Pacific section of the A.A.P.G. and the Pacific section of the Society of Paleontologists and Mineralogists concluded their seventeenth annual meeting here Friday after a 2-day session during which 13 papers were presented and another presented by title. On the concluding day of the meeting, Frank S. Hudson, of Shell Oil Co., Inc., was elected president, succeeding Albert Gregersen, of the Texas Co., who has served for the past year. E. J. Bartosh, of Bankline Oil Co., was reelected secretary-treasurer. District representatives are H. K. Armstrong and H. L. Driver, whose terms expire in 1941, and E. C. Edwards, whose term runs until 1942. The Society of Paleontologists and Mineralogists at their annual meeting held at the Clark Hotel Thursday night, November 7, elected Frank Tolman, of Richfield Oil Corp., as president for the succeeding year and W. T. Rothwell, Jr., of the same company, as secretary-treasurer.

E. C. Edwards, of General Petroleum Corp., presided at the first session on November 7 and the first order of business was an address by the national president of the association. The second paper was presented by Frederick Romberg, of Geophysical Service, Inc., on "Quantitative Introduction to Gravity Prospecting." The principles involved and operation of a gravity meter were discussed and a comparison was made between a gravity meter and torsion balance. W. P. Woodring, of the U. S. Geological Survey, collaborated with M. N. Bramlette, of the University of California at Los Angeles, in compilation of an excellent paper on "Late Miocene and Pliocene Stratigraphy and Paleontology of the Santa Maria District." Frank S. Hudson and G. H. White, of Shell Oil Co., Inc., discussed "Thrust Faulting and Coarse Clastics in the Temblor Range." It was brought out that in the region of Recruit Pass, the Temblor Range consists of Miocene strata overlain by pre-Cretaceous crystalline rocks and Oligocene and upper Miocene sediments of the Result Pass thrust sheet. This thrust cover was folded with the underlying strata, though in somewhat lesser degree. The Recruit Pass fault on the southwest flank of the range dips southwestward toward, and in places is seen to be cut by, a northwest-trending vertical fault. This is believed to be the northeasternmost element of the San Andreas Rift zone, a strip 2 miles wide covered by faulted Pliocene, bounded on the southwest by the line of recent activity that is generally called the Rift. The crystalline rocks are not native to the Temblor Range but were thrust over it from a source either within, or to the southwest of the Rift zone. The major movement on Recruit Pass fault was certainly pre-Quarternary and perhaps as early as latest Miocene. It is suggested that movement began during Santa Margarita (upper Miocene) and that the materials of the fanglomerate lenses in Santa Margarita shale found on the northeast flank of the range came from the crystalline rocks which were thrust into the area tributary to the basin of shale deposition. This paper received considerable attention from members present and discussion had to be limited because of the study it received.

Volumetric Methods of Recovery Estimation

John F. Dodge, of University of Southern California, and Howard C. Pyle and Everett G. Trostel, of Union Oil Co., presented a joint paper on "The Estimation by Volumetric Methods of Recoverable Oil and Gas From Sands." The formula for volumetric estimates involving factors for area, sand thickness, porosity, saturation, and recovery was reviewed and the need for modification and amplification of the factors was demonstrated. Individual factors were redefined in their new content and methods for their evaluation were outlined. The need for consideration of both physical and economic effects in the choice of a recovery factor was emphasized. Recovery factors for oil were distinguished from those for gases for co-occurring and produced oil and gas mixtures. Applicability of volumetric reserve estimates to engineering appraisals was discussed and inherent limitations of the procedure set forth. The authors pointed out that practical accuracy in volumetric estimates of oil and gas reserves is dependent upon both the accuracy and completeness of the data available and upon the skill and resourcefulness of the engineer and geologist in analyzing and visualizing reservoir conditions and fitting together the fragmentary data into a compatible whole. Similarities with, and differences from, other fields within his experience should be recognized as well as the practical limitations of the factors involved, their relative importance and relative weight.

Richard W. Fleming and M. C. Sargent, of the Scripps Institution of Oceanography, discussed the Accumulation of Marine Diatomaceous Sediments. The discussion included the oceanographic aspects of diatomaceous deposits with emphasis on the conditions favoring production of large numbers of diatoms in the surface layers of the water, as well as some of the factors which may affect the deposition and preservation of their skeletal remains.

Herschel L. Driver, of Standard Oil Co., presented a paper on the "Role of Foraminifera in the Oil Industry." It was brought out that data derived from foraminiferal investigations have been applied during the past 18 years as an aid in the solution of economic problems. Foraminifera and other organisms are used along with texture, hardness, and color of rocks, fluid and mineral content, electric logs and geophysical data as means of correlation. Richard W. Sherman, of British American Oil Producing Co., gave an informal talk on the geology of the Del Valle area and this extemporaneous talk led to considerable discussion. R. W. Norton delivered a paper on "Interpretation and Application of Electric Logs," during which he gave a brief description of the resistivity and self-potential curves and explained the various measurements which are made. The application of these measurements to geological correlations and interpretation of formation content was then discussed.

Harry R. Johnson, an independent consultant of Los Angeles, who spent a large part of last summer in the Marysville Buttes area, presented a series of slides and explained and discussed each as it was projected on the screen. Walter Stalder, to whom Mr. Johnson referred as the grandfather of the Marysville Buttes area, was present and joined in the discussion. It was brought out by Mr. Johnson that the Marysville Buttes are a strikingly isolated and circular topographic feature about 10 miles in diameter and rise nearly midway across the Sacramento Valley from a marginal elevation of less than 100 ft. to over 2,000 ft. in its craggy central portion. Geologically, the Buttes are believed unique as far as California is concerned because Mr. Johnson concluded successive volcanic and deformational episodes have greatly disturbed Cretaceous, Eocene, Pliocene, and possibly younger sediments in a broad peripheral zone, the outer margin of which is hidden beneath a thick mantle of volcanic ejecta originating at a central crater developed during the final phase of activity. Gas in commercial quantities has already been developed on the south side of the Buttes in sands of Cretaceous age, and evidence indicates other favorable structural traps for gas and possibly for oil elsewhere within the marginal area of the uplift. Field studies during the past summer have thrown new light upon Cretaceous-Eocene relationships and hitherto misunderstood structural conditions.

A. F. Woodward, of Stanley & Stolz, discussed conditions in the recently discovered deep Miocene production in the Inglewood field and

(Continued on Page 248)

S. A. E. Speaker Predicts Upsurge in Aviation

By W. T. ZIEGENHAIN

WAR is 85 per cent transportation," and "Industry is fast recognizing transportation as its principal sales-cost factor." These two statements were made at the 2-day annual meeting of the Fuel and Lubricants Division of the Society of Automotive Engineers which ended at Tulsa last Friday. These prompted the greatest amount of thought and discussion among the 150 refinery engineers and technologists present.

William B. Stout, aviation authority, discussed trends in aviation as they applied to motor fuels. He said he could visualize as many planes in this country as we now have automobiles. The production of the $2,000 family plane is being speeded up and that one manufacturer is placing purchase orders for supplies in anticipation of making 10,000 such planes in 1941. To the man with such a plane, he said, the State of Texas is no larger than the State of Rhode Island is to the man who drives a horse.

W. O. Taussig, engineer for the Burlington Transportation Co., operators of diesel-powered trucks, championed the use of these engines for this service and added new interest by enumerating the company's experience in operating fleets of such trucks in competition with gasoline trucks and railroads.

With the broad subject of supplying gasoline, lubricants, and diesel fuels for modern engines before the assembly, it soon became evident that the primary interest was in the relative cost per mile. One engineer went so far as to suggest that oil fuels, especially truck fuels, be sold on a ton-mile basis instead of a per-gallon basis.

Then, in speaking specifically of lubricating diesel engines, he said: "While no doubt experiments will and must continue to find new and better methods of compounding lubricants, it appears to us that the following conclusions can be reached considering present engine design and present available fuels:

"1. A pure unadulterated mineral oil does not produce satisfactory results, regardless of its quality.

"2. Any oil that breaks down in service into corrosive compounds must be treated with a neutralizing, corrosion inhibitor to protect copper-lead engine bearings.

"3. Most, if not all, lubricating oils require the addition of an oxidation inhibitor.

"4. The addition of a detergent is necessary to scour varnish-forming compounds from piston walls and from cylinder liners.

"We are not certain whether the lubricating oil or the fuel is responsible for varnish formation. At any rate we seem unable to prevent it. As long as this condition exists, it must be removed as effectively as possible."

On this subject, Dr. Ulric B. Bray, consulting chemist and engineer of Los Angeles, and formerly with the Union Oil Co., had this to say: "Stability of the lubricant against heat and oxidation has always been desirable, but with each advance in diesel-engine design and performance they assume greater importance. However, if the program of diesel-engine lubricating-oil research, which has led to such outstanding progress in many laboratories, had depended on laboratory tests 'in vitro' instead of 'in vivo' or upon trick engine tests employing conditions not expected to be realized in service, we would probably still be floundering amid theoretical speculations." He thereby stressed the high value of road tests.

He continued then by saying: "The question is frequently raised as to whether different diesel engines require different lubricating oils, and whether one compounded oil can lubricate most efficiently all makes of high-speed diesel engines. This question has naturally been foremost in the minds of those doing research on this subject, and much effort has been devoted to obtaining the facts required for a reliable answer.

Further on the subject of heavy-duty lubrication, H. R. Wolf, head of the chemical research laboratories for the General Motors Corp., said, "The stress on the crankcase oil under heavy-duty operating conditions can be lowered by reducing the oil temperature. This, however, is only a temporary solution of the problem. The trend in engine design is definitely toward a higher specific output. Therefore, in any present design where temporary relief is obtained by lowering the crankcase-oil temperature, the designer immediately takes advantage of this reduction in temperature and increases the specific-power output."

As still another phase of heavy-duty lubrication, Martin S. Clittick, of the Pure Oil Co., called attention to the use of special greases and suggested that engineers recognize three types of motor lubricants. These he enumerated as (1) mineral oils; (2) mineral oils in admixture with other agents in which the viscosity of the mixture is not greater than the base oil, and (3) mineral oil in admixture with thickening agents such as metallic soaps in which the viscosity becomes greater than that of the base mineral oil.

S.A.E. meeting attendants. M. G. Colby and A. L. Heintze of Sinclair Refining Co.; T. P. Sands of the Gulf Research & Development Co.; G. M. McKee of the Nourse Oil Co., and Ulric B. Bray, lubrication expert of Los Angeles

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Oil Compact Engineering Committee Plans Activities During A.P.I. Meeting

CHICAGO, Nov. 12.—The Interstate Oil Compact Commission engineering committee, headed by E. De Golyer of Dallas, Tex., utilized the A.P.I. meeting here this week as the magnet which drew its members together for the purpose of planning its program.

Members of the I.O.C.C. engineering committee attending the A.P.I. included Mr. De Golyer, Dr. W. H. Carson, Norman, Okla.; Dr. Eugene A. Stephenson, Lawrence, Kans., and Lee S. Miller, Lansing, Mich. Other members of the committee are Dr. F. N. Van Tuyl, Golden, Colo., and A. Andreas, Santa Fe, N. M.

The engineering committee was appointed 2 weeks ago by Gov. Leon C. Phillips of Oklahoma, chairman of the Interstate Oil Compact Commission, to consider such factors as well spacing, methods of establishing allowables and the numerous other physical factors involved in conservation of oil under the authorized jurisdiction of the body.

Continental Buys Half Interest From Davis at Rincon

HOUSTON, Tex.—Continental Oil Co. purchased a one-half interest in the Rincon field, Starr County, from W. R. Davis Co., Inc., Houston, for a reported consideration of $6,000,000. The deal involved approximately 12,307 acres of land, an interest in 47 producing oil wells and 3 gas-distillate producers. The field was discovered in 1939 and is one of the most prolific fields in South Texas, being approximately 4 miles long and 3 miles wide with producing limits still undefined in several directions.

THE MARKETS*

CRUDE OIL: The general advance of 15 cents per barrel on Pennsylvania Grade crude oil inaugurated November 12 by South Penn Oil Co. broke a series of four successive declines starting last May 22. The eastern crude advance increased Bradford oil to $2 per barrel. North Texas producers selling their crude to Panhandle Refining Co. recovered part of the mid-July price cut effective November 1. Panhandle restored the regular North Texas gravity scale of crude postings for oil delivered to its Wichita Falls, Tex., refinery, meaning that producers absorb the transportation costs. The advance in North Texas is further evidence of more intense competition there for crude connections going to make up part of the reduction in supplies available in Illinois.

REFINERY: Tank-car-gasoline prices in Arkansas, Louisiana and Tennessee have been reduced generally 0.5 cent per gallon, excepting points that were previously subnormal. There were other scattered adjustments of local character including an advance of 0.2 cent per gallon at several New York and New England points. The northeastern advance was attributed largely to higher tanker transportation costs.

TANK-WAGON AND POSTED-DEALER: Southern dealer-tank-wagon prices followed the tank-car market into lower ground. Scattered revisions were made at a few other points but were local in character and were about equally divided between advances and declines.

FINANCIAL: Oil securities followed the general market in its post-election advance. The average of 30 representative stocks for the week ended November 9: High, 23.82; low, 21.81; close, 23.37. Week ended November 2: High, 22.71; low, 21.24; close, 22.43.

*Detailed information in Market Section.

Recycling group at Kingsville, Tex., meeting. The men are E. V. Foran, Judson Swearingen, R. L. Peurfoy, F. V. L. Patten, O. L. Roberts and E. E. DeBack. Dr. DeBack was elected president

American Recycling Association Formed at First Short Course

By GEORGE WEBER

THE American Recycling Association was organized last week at the first annual Short Course on Recycling and Pressure Maintenance held in cooperation with Texas College of Arts and Industries, Kingsville. Six technical papers were presented before an initial registration approaching 100 members who participated in discussions, field-inspection trips, and business meetings attending organization of the association.

Officers elected for the first term are: E. E. DeBack, Coastal Recycling Corp., Corpus Christi, Tex., president; Dr. O. L. Roberts, research department, Atlantic Refining Co., Philadelphia, Pa., vice president, and R. L. Peurfoy, Texas A. & I. College, secretary-treasurer.

In addition, the following members were elected to the board of directors: E. V. Foran, Foran, Knode, Boatwright and Dixon, Houston, Tex.; E. O. Bennett, Continental Oil Co., Ponca City, Okla.; William H. Vaughan, Tide Water Associated Oil Co. and Seaboard Oil Co., Palestine, Tex.; Clyde Alexander, Corpus Christi Corp., Corpus Christi, Tex.; Richard C. Alden Phillips Petroleum Co., Bartlesville, Okla.; W. F. Fulton, United Gas Pipe Line Co., Shreveport, La.; S. E. Buckley, Humble Oil & Refining Co., Houston, Tex.; Judson S. Swearingen, University of Texas, Austin Tex.; F. V. L. Patten, Texas Railroad Commission, Austin, Tex., and Henry Wade, Parkhill-Wade, Los Angeles, Calif.

Technical Sessions

Activity of association members at this first 2-day meeting consisted mainly in the study and discussion of several subjects relating to pressure maintenance. The technical sessions opened with presentation of a paper entitled "Methods of Condensate Recovery," by Henry Wade. The paper and subsequent discussion dealt with the types of condensate-extraction plants now in operation. This was followed by an inspection trip through three plants in the Agua Dulce field, operated by the Coastal Recycling Corp., Agua Dulce Co., and Lockhart Petroleum Co.

The second day's session began with the paper, "Prediction of Subsurface Flows," by E. V. Foran. A forum immediately following, brought a lengthy discussion of the effects of injection patterns, input-gas volumes, sand and structural characteristics, and weight differentials of lean and rich gases, upon the displacement of virgin gas with lean injected gas in reservoirs.

"Deviation of Natural Gas From Boyle's Law," by George Granger Brown, turned the discussion to the problems attending yield predictions, reserve estimates, and economics of recycling-plant operations.

The afternoon session opened with a joint paper presented by Dr. F. H. Dotterweich, associate professor, Natural Gas Engineering, Texas A. & I. College, and F. V. L. Patten, Texas Railroad Commission, entitled, "Physical Properties of Hydrocarbon Mixtures in Condensate Production." The theory concerning phase equilibria of hydrocarbon substances, the retrograde effect, and practical applications in well testing and sampling were discussed.

Following a descriptive paper on the "Operation of the Podbielniak Apparatus," prepared by Dr. Walter J. Podbielniak, the final paper of the course, "Gas Hydrates," was presented by Dr. O. L. Roberts, Atlantic Refining Co., Philadelphia, Pa. Dr. Roberts reported on work done in the study of hydrate formation of water and methane and water and ethane. The paper concerned the establishment of phase diagrams of the substances studied, and added to the technology of hydrate formation, as it applies to low-temperature condensate extraction in recycling plants.

Future Plans

Committee meetings and open sessions brought suggestions of services which the American Recycling Association may render the industry. Since the organization is newly formed, no definite program has yet been announced. However, enlargement upon the proposed annual short course is expected to include several activities.

The facilities of Texas A. & I. College will be offered for a proposed course of several weeks for recycling-company employes who may participate in research and study of subjects not now offered in engineering schools. There is a possibility that the association may take the lead in outlining and standardizing test procedures and nomenclature, pertaining directly to recycling operations.

For the present, its principal service is the establishment of the annual short course as a medium for exchange of information and study of new developments in recycling and pressure maintenance.

DEATHS

GEORGE E. ELLIS, 49, cartograher for the Salt Dome Oil Co., Houston, Tex., died November 4 at his home in Houston. A native of Bristol, Pa., Mr. Ellis had been a resident of Houston for 7 years. His widow survives.

JAMES S. ALCORN, president of the Alcorn Combustion Co., died suddenly November 5 at Wynnewood, Pa. Mr. Alcorn attended the University of Pennsylvania Law School. After being admitted to the Pennsylvania bar, he was for a number of years associated with the law firm of Simpson & Brown. During and following his practice of law he became interested in several companies doing business in the heating art. For the past 17 years he has been president of Alcorn and had patented a number of inventions in the art of heating petroleum for the production of motor fuel. He was also a director of the Faber Engineering Co.

ARTHUR E. NASH, vice president and treasurer of the Alcorn Combustion Co., died in Philadelphia, Pa., on October 29. Mr. Nash, a graduate of Massachusetts Institute of Technology, class of 1902, worked many years with the Du Pont Co. as a research chemist, and later became vice president of the Philadelphia Rubber Co. He resigned that position to become vice president and treasurer of the Alcorn company at the time of its organization in 1923. He holds in his name a considerable number of patents and was the author of several articles relating to the heating art.

THOMAS ALONZO CRAWFORD, 63, in charge of the maintenance and construction forces of the Kendall Refining Co., Bradford, Pa., was killed when struck by two cars in front of his home on November 6. Born in Butler County, Pennsylvania, Mr. Crawford has resided in Bradford most of his life. He had been employed by Kendall for 35 years. He leaves two brothers and a sister.

DR. MANUEL GUADALAJARA, native government petroleum inspector in Venezuela, died of exhaustion and exposure after he and several other oil men were marooned on a fishing expedition off the coast of Venezuela. Dr. Guadalajara was graduated from the University of Tulsa in 1933. He leaves his widow, the former Irene Bradshaw, of Tulsa.

CHARLES W. McKEEN, 51, superintendent in West Texas fields for the Barnsdall Oil Co., died of a heart attack last week at his home near Odessa, Tex. He had been with the Barnsdall company since 1915. Survivors include his widow, a son and a daughter.

WILLIAM PAUL REA, 46, of Tulsa, and an employe of Stanolind Pipe Line Co. for 12 years, died November 6 at a Muskogee, Okla., hospital. Prior to his joining Stanolind in 1928, he was employed in the construction of a trunk line from Wyoming to Freeman, Mo., in 1923, and later was employed by Prairie Pipe Line Co. Interment was at Carrollton, Mo. He is survived by his widow and a daughter.

E. C. SMITH, 58, a long-time resident of Center, Tex., died at Shreveport, La., November 5, after a short illness. Mr. Smith had been active in leasing operations for major oil companies for 20 years, and is reputed to have leased more acreage in East Texas than any other man. His wife and three daughters survive.

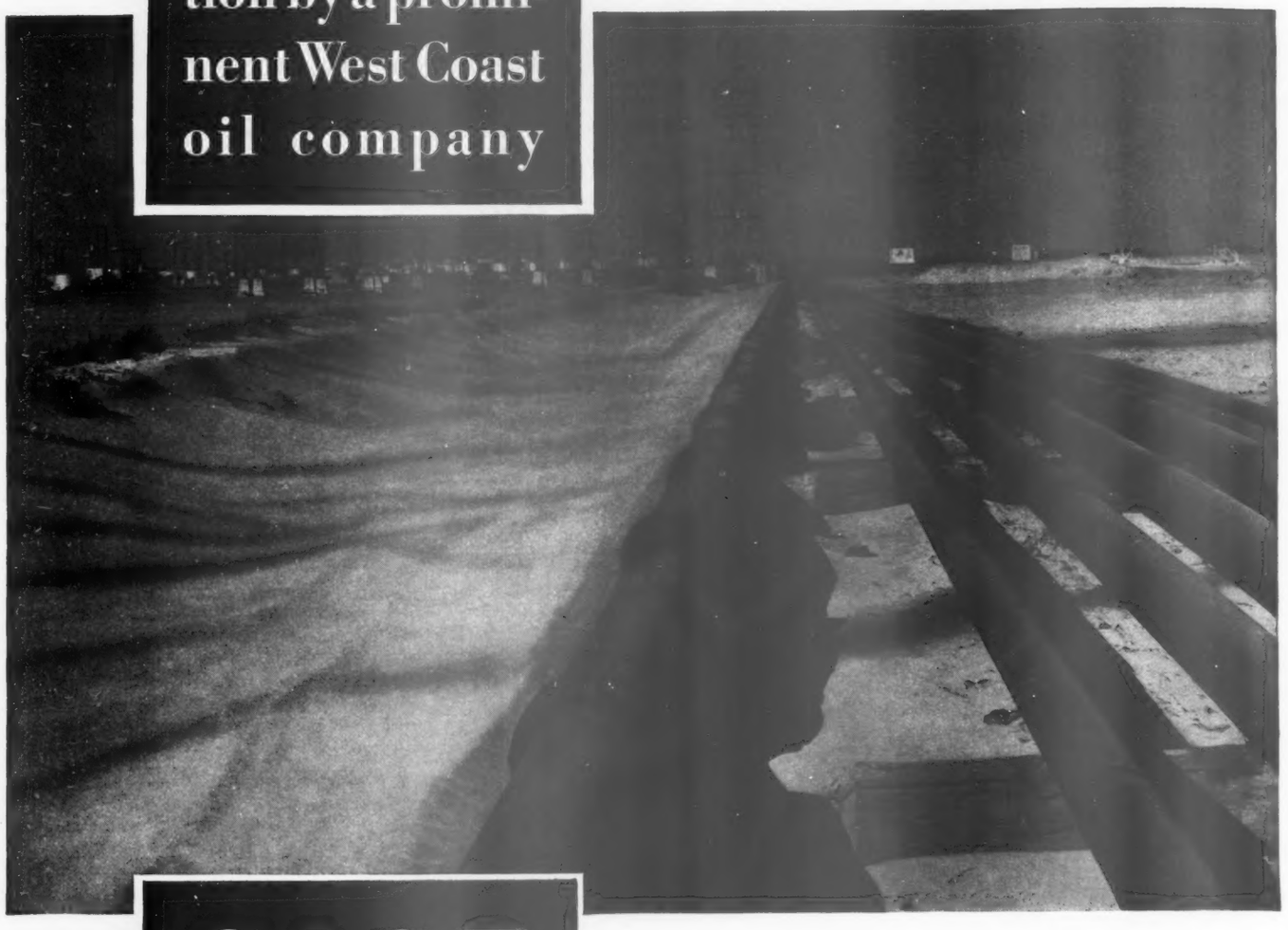
JOHN A. VICKERS, 49, president of Vickers Petroleum Co., Wichita, Kans., died there November 11 after a long illness, death resulting from a hemorrhage from a stomach ulcer. Born at Lowell, Kans., Mr. Vickers grew up on a farm near Liberal and for many years was a resident of Wichita. He owned numerous wells throughout Kansas and operated a refinery at Potwin, Kans. He was a director of the Independent Petroleum Association of America from 1936 to 1939 and was also a director of the American Petroleum Institute. He is survived by the widow and eight children.

●

Three Perish in Drowning Accident in Maine

Paul M. Macklin, of New York, vice president of Wickwire Spencer Steel Co., and two companions were drowned late last week while on a hunting trip in the Maine woods, according to reports. The other victims were Mr. Macklin's son, John, a foreman in the company's Buffalo plant, and George W. Nelson, superintendent of the plant. Surviving members of the party reported that the three men were drowned while transporting a canoe across a thinly iced cove in Caucomgomuc Lake, about 10 miles north of Greenville, Me.

Cast iron pipe installed for drilling operation by a prominent West Coast oil company



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International

War . .

U. S. Oil May Be Reaching Germany

THE possibility that this country is supplying nearly 50 per cent of the motor fuel which Russia is reported to be shipping to Germany is indicated in the September report of the U. S. Bureau of Foreign and Domestic Commerce. This report reveals that in that month the United States exported 333,477 bbl. of motor fuel to Russia, a total which would be roughly half the 100,000 tons which the Soviet Union has been reported to be supplying Germany monthly. The fact that the U. S. Maritime Commission recently approved the chartering of additional tankers to Russia is regarded as an indication that the shipments to that country in September are being continued though possibly on a smaller scale.

During the first part of the war, Russia purchased comparatively large quantities of gasoline in the United States. However, these purchases, which averaged close to 300,000 bbl. per month in the first few months of the war, dwindled to 75,401 bbl. in January of this year and were then suspended entirely until August. In that month they totaled 150,693 bbl. and in September they were doubled.

Whether this motor fuel is actually reaching Germany is open to question for in order to do so, it would be necessary to transport it across Asia. It is doubtful if Russia has the facilities to do this. However, it is still possible, if this gasoline is not going directly to Germany, that it is replacing other motor fuel which is being sent to the Reich.

Of equal interest in the September Bureau of Commerce report are the data on exports to Japan. They show that Japan imported 549,892 bbl. of gasoline from this country in that month. Exports to Japan included 115,051 bbl. of "high-grade motor fuel," a designation that was formerly "aviation gasoline." Our combined gasoline exports to Russia and Japan in September were 52 per cent of our total and, as a result, Asia has replaced Europe as our principal export market. The only other large purchasers of gasoline then were Canada, 172,496 bbl., and Spain, 129,022 bbl.

The trend of our exports to the two dominant Asiatic countries through this year is shown in the following table taken from the Bureau of Foreign and Domestic Commerce reports:

(Figures in barrels)

Month—	Russia	Japan
January	75,401	119,178
February	.....	106,108
March	.....	76,289
April	.....	16,714
May	.....	29,069
June	.....	5,048
July	.....	124,892
August	150,693	95,267
September	333,477	549,892

It is entirely possible that these shipments to Russia are an important factor in maintaining its neutrality. This possibility is indicative of the delicacy of the international situation for to deny them may mean that Russia would side with the Axis but it may also mean that the Axis powers, possibly desperate for oil, might go through with a plan they are believed to have considered, that of driving to the more accessible Caucasian fields, in preference to those of Iran and Iraq. Russia also holds a commanding position in Germany's projected "Berlin-to-Bagdad" campaign which includes seizure of the Persian and adjacent fields.

A somewhat comparable situation exists with respect to Japan. A complete embargo of shipments to the far eastern Axis partner could easily result in a Japanese invasion of the Netherlands East Indies, the only other convenient and adequate alternative source of supply. This possibility may be entirely erased with the successful completion of negotiations for the sale of oil to Japan which have been going on between representatives of British and American oil companies in the Netherlands East Indies and the Japanese Government. Richard Austen Butler, parliamentary undersecretary for foreign affairs, told the House of Commons last week that the negotiations were progressing.

These negotiations were undertaken some time ago and were believed to be nearing a successful conclusion in September when the oil companies' representatives and Minister Kobayashi of Japan met in Batavia. When Mr. Kobayashi returned to Tokyo it was assumed that the negotiations had reached an impasse despite the announcement that he had returned merely for the purpose of reporting to the government. Until last week's announcement by Undersecretary Butler, no word regarding the negotiations had been issued since Mr. Kobayashi's return.

Rumania . .

Oil Region in Center Of Recent Earthquakes

COMPLETE disruption of the Rumanian petroleum industry by one of the most destructive earthquakes in history is likely to have profound bearing on the European war. Epicenter of the quake was in the oil region. Even liberal discounts for the natural tendency of first reports to be exaggerated leave the outlook particularly serious for the Axis powers.

Movement of Rumanian petroleum to Germany through the Danube River and the port of Giurgui normally ceases at the end of December. River traffic is not usually resumed until the middle of April or May 1. Shipments of Rumanian petroleum to Germany last winter when the Danube was closed averaged less than 500,000 bbl. per month compared to 1,400,000 bbl. during part of the past summer.

Rumania has been producing about 125,000 bbl. daily during the past few months and approximately 50,000 to 60,000 bbl. daily is available for export. Since British companies were placed under direction of the Rumanian Government and in light of recent war developments, the bulk of Rumanian petroleum shipments has gone to Germany and Italy.

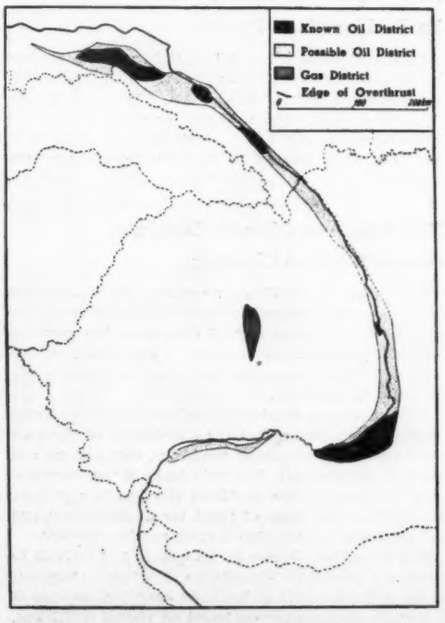
Approximately 80 per cent of Rumania's refining capacity of 240,000 bbl. daily is located at Ploesti and Campina or in smaller towns nearby. Details of the damage to refineries and producing properties will be delayed weeks in reaching this country if recent experience in communicating with Rumania is symbolic.

The Carpathian Mountains and Transylvanian Alps are a part of a great mountain system extending from the Alps into eastern Asia. This chain has been thrust to the north during Tertiary and Recent times for a distance of many miles and the thrusts are still continuing, with the result that this belt is one of the world's most active earthquake zones.

Facing Rumania, the mountains sweep around in a great arc and have overridden a plain which is not unlike the Texas-Gulf Coastal Plain in age and original character. The forward thrust of the mountains has ploughed into this coastal plain and thrown it into a great series of complex folds with great wedge-shaped thrust blocks. Like the Gulf Coastal Plain, the Rumanian Plain has great thicknesses of salt, but these are much nearer the surface than the beds from which the salt domes of Texas rise. This salt has acted like a lubricant so that thrusts from the mountains are intensified in the softer coastal-plain deposits.

In Poland, the forward thrust of the mountains has overridden the oil-bearing zone, but in Rumania the oil lies just in front of the mountains. As the oil deposits are closely associated with salt deposits and salt domes, any thrust from the mountains will tend to cut off or cave in the wells and the fractures that develop around the drilled areas will permit the escape of oil to the surface. Judging from accounts now available this is what has happened during the past few days in Rumania.

Operators in earthquake zones in the United States have generally to deal with movements along steep or vertical faults which do not greatly affect oil production. If, however, one can visualize the effect on the Gulf Coastal fields of moving a block like the Sabine uplift south for a distance of 50 or more miles he will get a picture of the complexity of the Rumanian structures as well as the disturbance caused in the fields by the present movements.



Map showing relationship between Carpathian Mountain front and Polish and Rumanian oil districts

Refinery Expansion

Expansion of Magnolia Refinery Under Way

FORT WORTH, Tex.—M. W. Kellogg Co. last week started work on the enlarging program for Magnolia Petroleum Co. at its refinery here. With about 7 months expected to complete the job, operations will not be halted at any time except at the period when the new units are tied in. The program is for enlarging the capacity of the refinery from 5,000 bbl. daily to 20,000 bbl. New straightrun, cracking, and reforming equipment, as well as additional storage will be constructed.

As an outlet for a portion of the products from the enlarged refinery, Magnolia Pipe Line Co. has completed its 200-mile line from Fort Worth to a point near Oklahoma City, Okla. The 4½-in. line was laid by Williams Brothers Corp.

Federal Buying of Aviation Gasoline Being Held Up

WASHINGTON, D.C.—The program for buying and storing high-octane aviation gasoline apparently has been abandoned or at least indefinitely postponed.

The Army and Navy will buy considerable quantities, probably in the neighborhood of 3,000,000 bbl. during the next 8 months, and will store it in its own reserve tanks now under construction at various strategic points. Earlier plans, however, called for the purchase of more than twice this amount, the balance to be stored by the producing refiners. A detailed program was worked out by the National Defense Advisory Commission, and the R.F.C. set up a subsidiary, the Defense Supplies Corporation, especially for the purpose, and it appeared that everything was set for the program to go ahead.

The difficulty appears to be largely legal difficulties and government red tape. The Army and Navy feel that they may not have legal authority to pay interest or storage charges to the R.F.C. or may lack authority to make commitments to purchase gasoline beyond the end of the fiscal year. Later, congressional authority may be given to go ahead with the program, but for the present it appears to be stymied.

New Wisconsin Refinery Soon To Be Placed on Stream

CHICAGO.—Wisconsin Oil Refining Co. is preparing to place its new plant at Sheboygan on stream during the latter part of this month. The new refinery, the first in Wisconsin, is located on the waterfront of Lake Michigan just north of Milwaukee. Capacity is 5,000 bbl. daily. Dewey E. Foster is president of the company.

New Petroleum Phenolic Distillates Prompt Standard Changes

New phenolic distillates recovered from petroleum have properties superior to some recovered from coal and the U. S. Department of Commerce has sent out proposed specifications to serve as a standard for disinfectants which standards will recognize the availability of these products.

F. W. Reynolds, head of the federal division of Trade Standards has undertaken the distribution of these revised specifications among producers, distributors, and users of disinfectants. The principal change, however, is in the name which has been changed to "phenolic disinfectants" in place of "coal tar disinfectants" and the proposed specification carries number TS-2962.

Except for the change in paragraph 3 of CS70-38 to admit the petroleum phenols, no significant change is made. Although CS71-38 has been rewritten because of a division into two groups based on phenol coefficient, the requirements of the two groups are not essentially different from the requirements of CS71-38, except admitting the phenols of petroleum origin. Lower solubility is required of Group 2 disinfectants, but this is compensated to some extent by the higher phenol coefficients.

Those receiving the revisions are asked to pass upon them and to vote their acceptance or rejection on the form supplied and to return it to the Division of Trade Standards of the National Bureau of Standards, Washington, D. C.

Wolverine-Empire Improving Oil City Refinery

OIL CITY, Pa.—Improvements, costing from $60,000 to $70,000, are planned or under way at the plant of the Wolverine-Empire Refining Co. at Reno, Oil City suburb. A. W. Scott, vice president and general manager, said improvements would be made in the retort department and filter house. A new laboratory is being erected to replace that destroyed by fire several months ago.

A specially made bauxite cooler will be installed to speed up operations in the retort department. An all-metal elevator is now being erected. An addition to the filter house is planned to house seven 20-ton capacity filters, which have been ordered. A set of bauxite conveyors is also planned.

The new laboratory will be equipped with the most modern labor equipment and will contain an engine-testing laboratory. All of the equipment of the old laboratory was destroyed in the fire.

Natural Gas

Wisconsin Commission Assumes Authority Over Pipe Lines

MADISON, Wis.—Whatever may be decided as to state or federal jurisdiction over pipe lines entering Wisconsin, the Wisconsin Public Service Commission has assumed authority, in effect, of determining whether or not natural gas shall be used in this state.

Pending decision on applications of Western and Independent natural-gas companies for permission to build Wisconsin pipe lines, the commission has announced an amendment to a May 1937 general order governing construction and installation of plants and facilities by gas companies.

Two modified rules, as announced, provide that unless and until the commission shall have certified that public convenience and necessity require it, no public utility furnishing gas shall construct any new plant or facilities, nor extend or alter any existing plant to connect with or adapt its facilities to a new or different source or kind of gaseous fuel; nor shall it "substitute one kind of gas to be sold to the public for another."

The rules were made public with a "flat denial" of allegations that the commission had avoided assuming jurisdiction over applications of the pipe-line companies. The allegations, it said, were printed on unsigned cards and presumably distributed throughout the state. One of the alleged statements denounced as false was that "the Federal Power Commission had announced that it would not take jurisdiction but after two requests from (John) Kaiser, who at the time was secretary of the (Wisconsin) commission, the Federal Power Commission stepped into the picture."

"The truth is," said the state commission, "that federal authorities invited us to take part in their investigations. At no time did we ask the federal commission to assume jurisdiction. In fact, the question of jurisdiction has not yet been decided by them.

The statement explained that the first application from a natural-gas company was received by the Wisconsin commission late in June 1940. A few days later the federal commission reported applications had been filed with it, and in conformity with its plan of cooperative procedure with state regulatory commissions, invited the Wisconsin board to notify the federal agency of its preference as between a conference, creation of a board, or a joint hearing.

Within a few days, the Wisconsin commission said, it requested the formation of a joint board to investigate the natural-gas applications and invited commissions in other states affected to participate in the request. Later it notified the Federal Power Commission that Wisconsin was proceeding with an independent hearing on jurisdictional questions and left the matter of cooperation between federal and state bodies to be determined by the federal agency. The state's independent hearing was held in Madison August 26, and the Wisconsin commission was represented at the Federal Power Commission hearing here from October 7 to 28.

Pointing out that questions of jurisdiction have not been decided either by the state or federal commissions, the Wisconsin body said: "Statements that we requested the Federal Power Commission to assume jurisdiction are false. We have held one separate hearing and shall hold such further hearings as our jurisdiction and powers permit."

Increase Shown in Texas Gas Production in September

AUSTIN, Tex.—Texas' natural-gas production averaged 4,309,717,000 cu. ft. daily during September, an increase of 143,453 over August and 778,272,000 cu. ft. greater than September last year, the Railroad Commission reported in its monthly statement.

Natural-gasoline plants took 2,414,445,000 cu. ft. daily during the month, 54,099,000 cu. ft. more than August but slightly less than September 1939. During the month, gasoline recovery increased, the daily average amounting to 2,293,258 gal. compared to 2,276,338 in August. Compared to a similar period last year, this represented the appreciable gain of 83,984 gal.

Production of carbon black increased to 1,291,177 lb. daily, a gain over August of 14,917 but a decrease of 10,151 lb. from a year ago.

Deliveries to pipe lines increased 51,466,000 cu. ft daily over August, the total deliveries amounting to 1,291,218,000 cu. ft. daily during September, indicating the customary seasonal increase. With regard to last year during the same period, 65,415,000 cu. ft. daily more were delivered this month than at that time, indicating the continual overall increase from year to year.

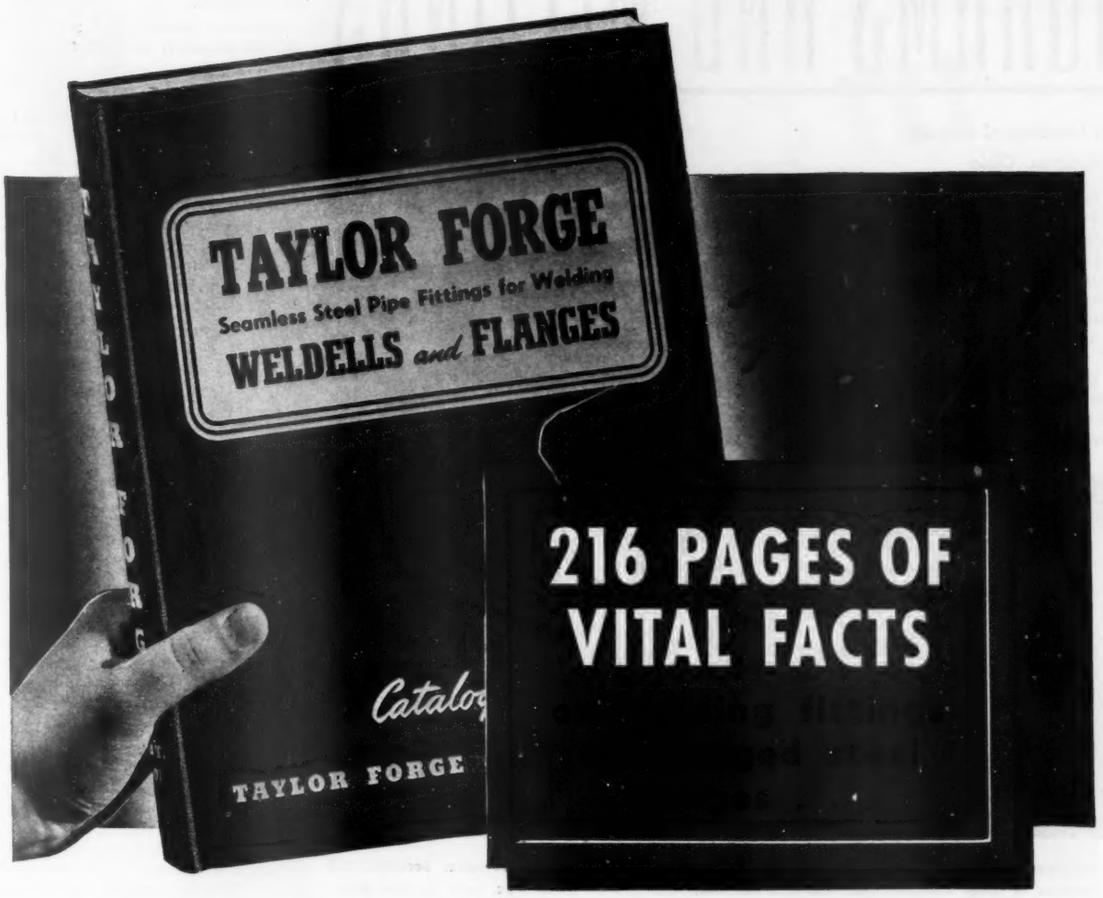
Natural Gasoline

Natural-Gasoline Production Gains in September

Production of natural gasoline increased in September 1940, according to the monthly report prepared by the Bureau of Mines. Daily average in September was 6,588,000 gal. as compared with 6,341,000 gal. in August. The outstanding gains in production occurred in the Texas Panhandle, Texas Gulf Coast and Appalachian districts. Following is a comparison of the September production of the various states or districts, in thousands of gallons, as compared with their August outputs:

	Sept., 1940	Aug., 1940	Jan.-Sept., 1940
Appalachian	5,315	4,463	56,363
Ill., Mich., Ky.	3,182	2,759	22,118
Oklahoma	33,265	33,739	299,060
Kansas	4,768	4,788	46,360
Texas	82,619	79,107	663,751
Louisiana	9,304	9,723	79,927
Arkansas	2,977	3,125	24,427
Rocky Mountain	7,800	8,347	68,503
California	48,422	50,509	436,753
Total	197,652	196,560	1,697,262
Daily average	6,588	6,341	6,194

Stocks at refineries, and plant and terminals decreased from 323,484,000 gal. the first of the month to 295,596,000 gal. on September 30, the report stated. This, the first decline since December 1939, left stocks about 48,000,000 gal. above those of a year ago. Stocks at refineries on September 30 amounted to 144,480,000, as compared with those of 152,544,000 gal. on September 1, while inventories at plants and terminals on these two dates were 151,116,000 and 170,940,000 gal. respectively.



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PROGRAMS AND MEETINGS

Appalachian Geological Society Meets in Columbus, Ohio

COLUMBUS, Ohio.—The Appalachian Geological Society convened for its first Ohio meeting, November 1, at the Fort Hayes Hotel. Geologists from Illinois, Indiana, Kentucky, Ohio, West Virginia, and Pennsylvania, and professors and students from Central Ohio colleges were in attendance. The meeting was in charge of J. R. Lockett, president of the society. Daniel J. Jones, state geologist of Kentucky, gave a summary of the recent geologic research in Kentucky. Paul H. Price, state geologist of West Virginia, presented an illustrated talk on the geologic history of the Appalachian area. Wilber Stout, state geologist of Ohio, spoke on the historical development of the petroleum industry prior to the drilling of the Drake well. On the following day, Dr. J. Ernest Carman, chairman of the department of geology at Ohio State University, conducted a field trip covering an area northeast of Columbus where exposures of the Berea sandstone and Bedford and Sunsbery shales were studied.

Five Oil and Gas Papers at Illinois Building Dedication

The oil and gas section of the Mineral Industries conference to be held in conjunction with the dedication ceremonies of the new Illinois Natural Resources Building will include five papers to be presented on Saturday morning, November 16, in Room 228 of the Natural History Building. Following are the papers to be presented:

1. Some Practical Applications of Geology in Illinois Rotary Drilling, by L. A. Mylius, consulting geologist, Bell Brothers.

2. Recent Advances in Illinois Drilling, Bart DeLaat, division engineer, Pure Oil Co.

3. Production Engineering, by D. H. Duke, petroleum engineer, Shell Oil Co., Inc.

4. The Gas-Injection Project at Louden, by W. F. Elting, petroleum engineer, Carter Oil Co.

5. Oil in International Relations, by W. H. Voskuil, mineral economist, Illinois Geological Survey.

Of considerable interest to geologists will be the symposium on the Devonian system which consists of 11 different addresses delivered by members of geological department of states in which the Devonian is of considerable importance. The program also includes sessions to coal, rock, and rock products, economics of industrial minerals, clays, and ceramic products and inspection and laboratory trips. The dedication ceremonies will open on November 14 and extend through November 16.

Daniel J. Jones, state geologist of Kentucky; J. R. Lockett, president of the Appalachian Geological Society; Paul H. Price, state geologist of West Virginia, and Wilber Stout, state geologist of Ohio, who were in attendance at the Columbus meeting of the Appalachian Geological Society

Asphalt Conference Will Attract Thousands to Dallas

An unusual coordination of government, science and industry to discuss the practical application of asphalt to the highway and airport defense program of the nation will be effectively demonstrated at the thirteenth National Asphalt Conference to be held at Dallas, Tex., during the week of December 9.

Cooperating with the Asphalt Institute will be the U. S. Public Roads Administration, the Highway Research Council, the Association of Asphalt Paving Technologists and the state Highway Department of Texas.

Featured subjects will include: Highways and Airports for National Defense, Reinforcing and Widening Existing Highways, Elimination of Bottlenecks, Highway Principles Applicable to Airports, Asphalt for Erosion Control and Railroad Ballast and Asphalt Pavement with Reference to Subgrade Support.

It is estimated that several thousand engineers, technologists, contractors, public officials and representatives of industry will make this the greatest convention of its kind ever held.

CALENDAR OF EVENTS

November

AMERICAN PETROLEUM INSTITUTE, twenty-first annual meeting, Stevens Hotel, Chicago, November 11-15.

OKLAHOMA MINERALS INDUSTRIES CONFERENCE, University of Oklahoma, Norman, Okla., November 19.

December

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, New Orleans, La., December 2-6.

MID-CONTINENT OIL AND GAS ASSOCIATION, annual joint meeting of standing committee on state and local taxation, and standing committee on federal income and excise taxation, Hotel Tulsa, Tulsa, December 5-6.

AMERICAN PETROLEUM INSTITUTE, Illinois Basin chapter, Southern Gardens, Salem, Ill., December 6.

NATIONAL ASPHALT CONFERENCE, Adolphus Hotel, Dallas, Tex., December 9.

NATIONAL CHEMICAL EXPOSITION, Stevens Hotel, Chicago, December 11-15.

PETROLEUM ELECTRIC POWER ASSOCIATION, Heidelberg Hotel, Baton Rouge, La., December 12-13.

MID-CONTINENT OIL AND GAS ASSOCIATION, annual meeting of general board of directors, Tulsa Club Roof, Tulsa, Okla., December 16.

1941

January

SOCIETY OF AUTOMOTIVE ENGINEERS, annual meeting and engineering display, Book-Cadillac Hotel, Detroit, Mich., January 6-10.

LIQUEFIED PETROLEUM GAS ASSOCIATION, eastern section, regional meeting, New York, January 16-17.

COMPRESSED GAS MANUFACTURED GAS ASSOCIATION, INC., annual meeting, New Nork, January 20-21.

NORTHWEST PETROLEUM ASSOCIATION, Radisson Hotel, Minneapolis, Minn., January 23-24.

February

NORTH TEXAS OIL AND GAS ASSOCIATION, Wichita Falls, Tex., February 22.

LIQUEFIED PETROLEUM GAS ASSOCIATION, INC., annual convention, Chicago, February 24-25.

AMERICAN PETROLEUM INSTITUTE, south western district regular spring meeting, Washington-Youree Hotel, Shreveport, La., February 27-28.

March

AMERICAN SOCIETY FOR TESTING MATERIALS, Hotel Mayflower, Washington, D. C., March 3-7.

AMERICAN PETROLEUM INSTITUTE, Pacific Coast District, Division of Production, regular spring meeting, Biltmore Hotel, Los Angeles, Calif., March 11.

April

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS, twenty-sixth annual meeting, Rice Hotel, Houston, Tex., April 2, 3, and 4.

AMERICAN CHEMICAL SOCIETY, St. Louis, Mo., April 7-11.

SOUTHWESTERN GAS MEASUREMENT SHORT COURSE, College of Engineering, Oklahoma University, Norman, Okla., April 15-17.

AMERICAN PETROLEUM INSTITUTE, eastern district, Division of Production, regular spring meeting, William Penn Hotel, Pittsburgh, Pa., April 17-18.

NATURAL GASOLINE ASSOCIATION OF AMERICA—Annual convention, Baker Hotel, Dallas, Tex., April 23-25.

PETROLEUM INDUSTRY ELECTRICAL ASSOCIATION, Mayo Hotel, Tulsa, April 23-25.

NATIONAL PETROLEUM ASSOCIATION, semi-annual meeting, Hotel Cleveland, Cleveland, Ohio. April 24-25.

September

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, Petroleum Division, East Texas chapter, annual convention, Adolphus Hotel, Dallas, Tex., September 25-27.

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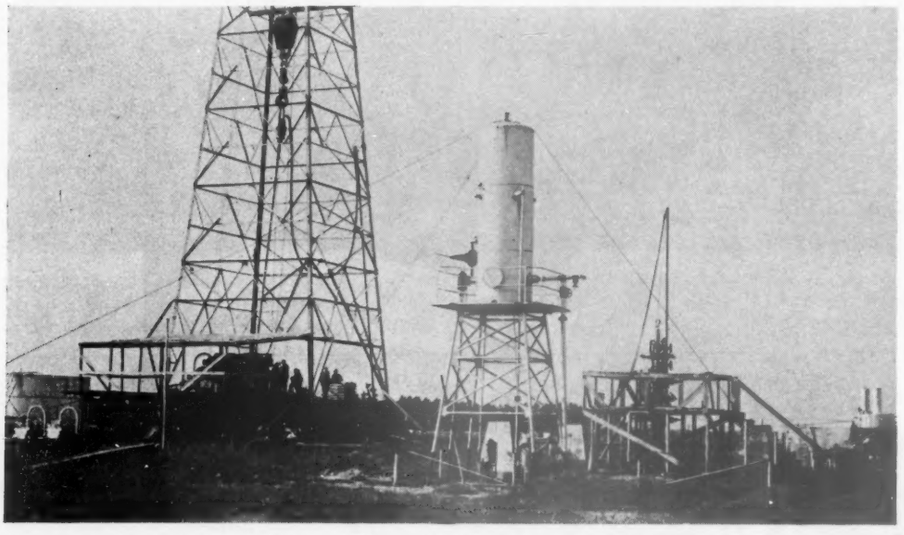
Finding of Deeper Pay Revives Iowa Field in South Louisiana

By NEIL WILLIAMS

HOUSTON, Tex. — Redrilling, either by new wells or by deepening of old producers, of the Iowa field, Calcasieu and Jefferson Davis parishes, coastal Louisiana, is in the making as a result of the recent uncovering of a prolific lower producing horizon. Already the field, which has been inactive except for occasional tests for several years following proving up of the previously known sands, has taken on new life, and now five drilling rigs are running in carrying new tests and old wells to the deeper zone.

Until now the deepest and principal producing horizon of the field has been the 6,900-7,000-ft. Marginulina sand, in which the discovery well was completed in October 1931. The deeper horizon lately opened has been found just below 8,200 ft. in the lower Frio section. Although the discovery well of this sand has been completed only since the middle of August, two additional wells have been brought in, and a fourth is in the sand. Six rigs are running.



Magnolia 1 Wait, discovery well of Iowa field, completed October 1931 in 6,900-7,000-ft. sand, still flowing with total recovery to date of 1,700,000 bbl. At left is 14 Wait, drilling as a twin well to the new 8,200-ft. sand

Discovery of the new sand came with the deepening by Magnolia Petroleum Co. of its No. 9 Wait, a former 6,900-7,000-ft. sand well which had gone off production from that sand. Just a little to the northeast of the middle and highest part of the field, the location was considered favorable for undertaking an exploratory test of lower horizons. The well was one of the later 7,000-ft. sand completions in the field, having been brought in in October 1934.

Sand was topped at 8,200 ft. The first 13 ft. consisted of sand with some shale, but from 8,213 ft. to 8,237 ft., where drilling stopped, the sand was clean, and richly saturated. Bottom of the hole is in the sand, and indications are that the sand section is much thicker than the approximate 40 ft. already taken in.

For completion of the well, a full string of 5-in. casing was run to bottom of the hole and cemented. This was perforated with 24 ½-in. holes at 8,230-36 ft. The well started flowing at 3 p.m., August 16, and was turned into the tanks at 6 p.m. the same day. On potential gage it flowed 653.28 bbl. of pipe-line oil in 24 hours through a ¼ by 6-in. positive choke, with 1,500 lb. working pressure on the tubing and 1,750-lb. pressure on the casing. Gas-oil ratio was 737 to 1. Gravity of the oil was 36.2° A.P.I. (corrected for temperature).

The rig was skidded immediately to No. 4 Wait, 1,100 ft. northeast of No. 9, another former 6,900-7,000-ft. sand well which had gone off production. It originally had been completed in September 1933. The deeper sand was found in this well at almost exactly the same depth as in No. 9, with bottom of the hole at 8,237 ft., the exact depth. As in No. 9, a full string of 5-in. casing was cemented on bottom, and then perforated at 8,225-36 ft. It gaged on potential flow 769 bbl. of pipeline oil in 24 hours through a ¼-in. choke.

At the same time, Magnolia Petroleum Co. moved in a second rig for No. 14 Wait, a twin to No. 1 Wait, the discovery well of the field, which still is producing from the 7,000-ft. sand. No. 14 Wait was located 330 ft. out of the southeast corner of the Wait lease, while the discovery well is 225 ft. out of the corner. Drilled to a total depth of 8,439 ft., No. 14 was plugged back to 8,220 ft. in the deep sand, where casing was perforated at 8,198-8,208 ft., and the well completed as the third producer in the sand, flowing 365 bbl. in 24 hours through a 12/64-in. choke. Rig has been moved to No. 16, a new test west of the discovery well.

With the starting of the latter test by Magnolia, Shell Oil Co., Inc., moved in a rig for its No. 32 Heyd, a south offset to the Magnolia test, and a twin to No. 2 Heyd, Shell's first well in the field, a producer in the 6,900-7,000-ft. sand, which was drilled as an offset to Magnolia's No. 1 Wait (drilled by Vacuum Oil Co. prior to merger of this company with Magnolia Petroleum Co.). The Heyd deep-sand test is 330 ft. out of the northeast corner of the Heyd tract, with No. 2 Heyd being 225 ft. out of the corner. It also has found the new sand but is drilling deeper for exploratory purposes.

Lately, Magnolia has moved the rig from its recently completed No. 4 Wait to No. 15 Wait, an entirely new test being drilled on the northwest flank of the field, about 1,500 ft. from the deep-sand discovery well. Shell, in addition, has moved in a second rig to deepen its No. 4 Fontenot, another former 6,900-7,000-ft. sand well, and an east offset to Magnolia's No. 4 Wait. Also, Glassell & Glassell have started a test in the sand in the southeast corner of the Bowman tract, an outpost location about 2,000 ft. northwest of the deep-sand discovery well, and outside the previously productive limits of the field, while Sid Richardson has started a test on the extreme south flank of the field, about 2,000 ft. from production.

Deeper Horizon Development

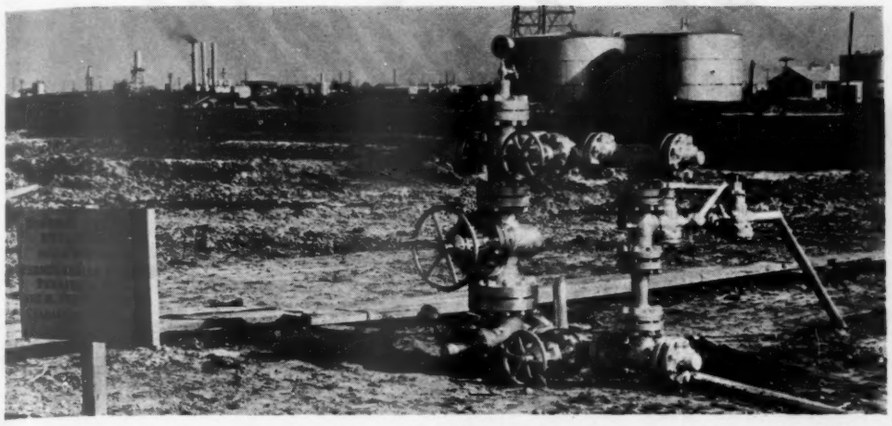
Development of the deeper horizon comes at a time when production in the 6,900-7,000-ft. sand is nearing exhaustion. During the past several years wells in this sand, due to encroachment of water, have been going off production with increasing rapidity until now there remain only 16 out of a total of 49 wells which have been completed in this sand. Some of the wells, as they have gone off production, have been plugged back to shallower sands, from which they still may be producing; others, which may not have been favorably located in respect to the shallower production, have been left standing, and, unless the holes are in bad condition, are subject to be deepened to the new deep sand.

Recovery from the 6,900-7,000-ft. sand has been

DEVELOPMENT AT IOWA FIELD IN SOUTH LOUISIANA

	Total tests drld.	Producing wells completed				7,000-ft. wells producing	Tests drlg.
		Total	7,000-ft. sand	8,200-ft. sand	Other sands		
Barnsdall Oil Co.	9	8	8	0	0	0	0
Magnolia Pet. Co.	23	18	†15	*3	2	3	2
Shell Oil Co.	61	57	26	0	31	13	‡2
Glassell & Glassell	0	0	0	0	0	0	1
Sid Richardson	0	0	0	0	0	0	1
Total	93	83	†49	*3	33	16	6

*Includes two former 7,000-ft. wells deepened.
†Does not include two former 7,000-ft. wells deepened to 8,200-ft. sand.
‡Includes one former 7,000-ft. well drilling deeper.



Magnolia 9 Wait, discovery well of the newly opened 8,200-ft. sand in the Iowa field, Calcasieu and Jefferson Davis parishes, coastal Louisiana, deepened from 6,900-7,000-ft. sand

obtained under exceptionally favorable conditions. Close to 40,000,000 bbl. of oil has been recovered from the field to date, of which all except approximately 5,000,000 bbl. has been from this sand. Practically all of this has been by natural flow, although a few wells have required some agitation by gas injection.

The sand has an extremely active water drive, and by close cooperation of operators in the field production practices have been followed that have made possible effective control and utilization of this drive in draining the reservoir. This is indicated in the fact that bottom-hole and well pressure today are practically the same as they were originally. With these pressures, wells in this sand can be flowed almost up to the time they are making 100 per cent water.

Under these conditions maximum recovery of oil from the reservoir is being made possible. The economic productive life of these wells has been materially extended, and some wells have remained on production making as high as 98 per cent and more of water. With them the main factor in their productive life has been the cost of handling the water produced.

Domal-Type Field

Iowa is a domal-type field, believed to overlie a deeply seated salt dome. Water moving in from all sides has encroached gradually and almost uniformly up structure on successively higher wells in the sand, with most of the present remaining producing wells in the sand being confined to a comparatively small area around the approximate top of the structure and in the middle of the field.

Thus, the discovery well (Magnolia's No. 1 Wait) being at approximately the highest point on the structure and about in the center of the field, is among those wells in the 6,900-7,000-ft. sand still on production. It has flowed continuously since it was completed in October 1931, and to date has recovered approximately 1,700,000 bbl. of oil. Present production is restricted to around 275 bbl. daily, and only comparatively recently has water started to show up. Water production still is only about 2 per cent but is slowly increasing. The well is expected to be one of the last to go off production.

Shallower sands, principal of which are those at 4,400-4,500 ft., 5,000-5,200 ft., 5,500 ft. and 6,600-6,700 ft., also have active water drive, but are more faulted and not so consistent as the lower sands. The shallower sands, except for the 6,600-ft. horizon, are of Miocene age, and more lenticular. Pumping has had to be resorted to on some of the shallow sand wells.

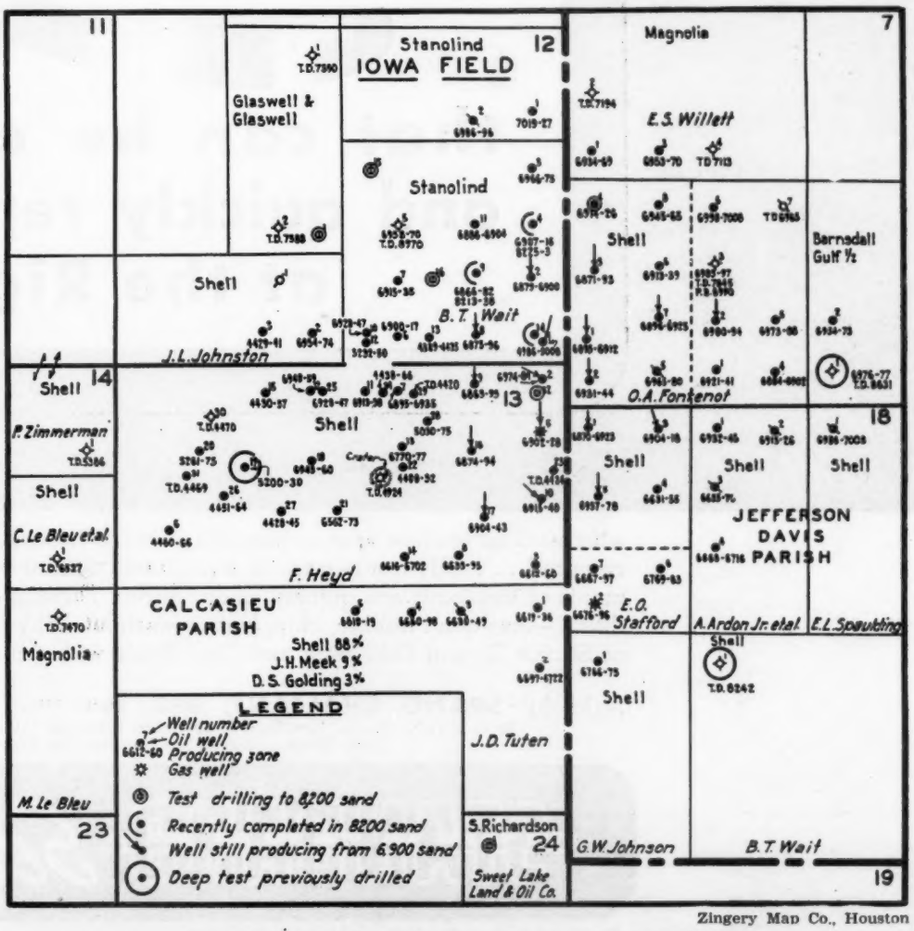
The new 8,200-ft. sand has given indications in wells so far completed of becoming the most prolific and important of any so far found in the field. A definitely thicker section already has been proved, and it is considered likely it will underlie a much larger area than the shallower sands, possibly extending well out beyond the limits proved for those sands. This is bringing acreage, particularly on the north and west sides of the field, into the play, including tracts previously drilled to the 7,000-ft. sand and condemned.

Until now there have been only three operating companies in the field, including Magnolia Petroleum Co. (originally Vacuum Oil Co.), Shell Oil Co., and Barnsdall Oil Co. However, with the deep-sand discovery, a tract just west of the present field on which Glassell & Glassell are drilling, is regarded as particularly promising for deep production, and to the north Stanolind Oil & Gas Co. has a tract on which development is expected to be started shortly. With the drilling by Sid Richardson on the south, another operator is being brought into the area.

Some definition of the extent of the new sand may be given by three tests previously drilled to depths below 8,200 ft., without getting the deep production. One of these, drilled by Shell Oil Co., Inc., on the southwest side of the field, was carried to a total depth of 9,161 ft. and then was plugged back to one of the shallower sands where it finally was completed. On the extreme east, Barnsdall Oil Co. drilled a test to 8,631 ft., without success, later completing the well in the 6,900-7,000-ft. sand. The other deep test, drilled by Shell, was located on the extreme southeast. It, however, went only to 8,242 ft. and in view of its downstructure position, it might not have been deep enough to find the deep sand.

In all, not including the new deep wells, 92 wells have been drilled at Iowa. Of these 82 have been completed as oil or gas producers. Except for one well, which blew out and cratered before reaching the producing sands, all dry holes have been at outpost or edge locations. Of the 82 producing wells completed, 49 have been completed in the 6,900-7,000-ft. sand, and 33 in one of the shallower sands. As previously stated, only 16 of the 6,900-7,000-ft. sand wells remain, but a number of these still are on production in shallower sands.

A spacing program of one well to 20 acres is expected to be carried out in development of the new deep sand, as compared with the 10-acre drilling of the other sands.



Zingery Map Co., Houston

Map of Iowa field, showing development in the 7,000 and 8,200-ft. sands

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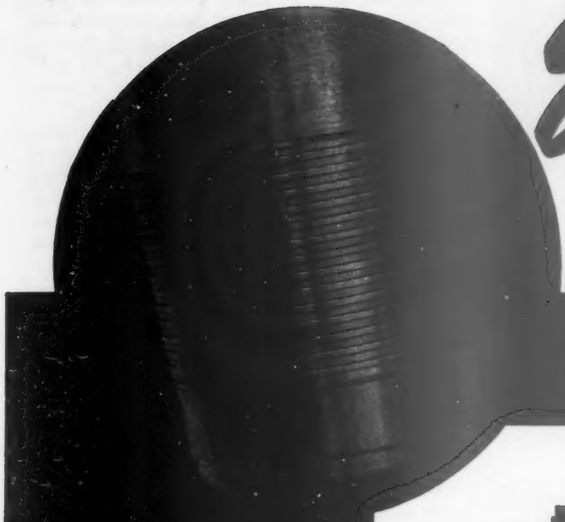

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STANDARD Seamless

New Pool in Prospect in Gallatin County, Illinois

By W. FARRIN HOOVER
Consulting Petroleum Geologist, Mount Vernon, Ill.

A POOL in New Haven Township 8s, Range 10e, Gallatin County, Illinois, has been in prospect for some time, ever since the Kingwood Oil Co. completed 1 Egyptian Tie & Timber Co. in Section 15 as a small producing well in the Cypress formation in July 1939. This well was drilled to the Fredonia but was plugged back to the Cypress (2,421-62 ft.) where it was completed as a 10-15-bbl. well. Additional tests were drilled in this area, but with the exception of the Angle-Eason 1 Duffy, 25-8s-9e, which made a total of 175 bbl. over a period of 6 months, all were dry holes. D. C. Colbeck 1 Egyptian Tie & Timber Co. was completed as a 200-300-bbl. well in September 1940. This well furnished subsurface and production data which suggests the presence of a pool in the neighborhood of 19-8s-10e. The Colbeck well is producing from the Rosiclare member of the Ste. Genevieve. The well is in Illinois, approximately 12 miles north of Old Shawneetown, the county seat of Gallatin County, and 8 miles east of Ridgeway.

Wells Previously Drilled

The accompanying table shows the wells drilled in this immediate area for which subsurface information is available.

Kingwood 1 Egyptian Tie & Timber Co., NE NW SE 15-8s-10e, completed July 1939, elevation 351 ft.

	Subsea elev.
Glen Dean	—1,756
Levias	—2,302
Rosiclare	—2,330
Fredonia	—2,350
Total depth	—2,499

J. Garfield Buell 1 Egyptian Tie & Timber Co., NW NW SE 16-8s-10e, completed June 1939, elev. 351 ft.

	Subsea elev.
Glen Dean	—1,793
Levias	—2,350
Rosiclare	—2,375
Fredonia	—2,382
Total depth	—2,608

Buford 1 Egyptian Tie & Timber Co., SW NE NW 22-8s-10e, completed September 1939, elev. 351 ft.

	Subsea elev.
Glen Dean	—1,756
Total depth	—2,127

J. Garfield Buell 1 Sutton, S½ NW NW 5-8s-10e, elev. 355 ft.

	Subsea elev.
Glen Dean	—1,905
Levias	—2,382
Rosiclare	—2,425
Fredonia	—2,432
Total depth	—2,655

Vanderbark 1 Busick, SE SE NW 11-8s-10e, elev. 351 ft.

	Subsea elev.
Glen Dean	—1,773
Total depth	—2,101

Angle-Eason 1 Duffy, NE NW NW 25-8s-10e, completed December 1939, elev. 369 ft.

	Subsea elev.
Glen Dean	—1,821
Levias	—2,410
Fredonia	—2,440
Total depth	—2,611

Ralph Halbert 1 Osburn, SE SE NE 29-8s-10e, completed August 1940, elev. 346 ft.

	Subsea elev.
Glen Dean	—1,808
Levias	—2,365
Rosiclare	—2,400
Fredonia	—2,481
Total depth	—2,587

D. Colbeck 1 Egyptian Tie & Timber Co., N½ NW NE 19-8s-10e, completed September 1940, 200-300 bbl., elev. 358 ft.

	Subsea elev.
Glen Dean	—1,852
Levias	—2,312
Rosiclare	—2,378
Total depth	—2,384

Showings of oil were found in the Degonia formation in D. C. Colbeck 1 Egyptian Tie & Timber Co., in the Tar Springs in J. Garfield Buell 1 Egyptian Tie & Timber Co., and in the Cypress in Buell 1 Egyptian Tie & Timber. This latter horizon made the small producing well in Kingwood 1 Egyptian Tie & Timber Co. The Rosiclare, which has an approximate thickness of 10 ft. on the crest of the structure in Section 19, is the producing horizon for D. C. Colbeck 1 Egyptian Tie & Timber Co. Although 210 ft. of Fredonia were logged in Halbert 1 Osburn, in Section 29, the McClosky pay zone in the Fredonia has not been found to be productive; but in Angle & Eason 1 Duffy, the McClosky produced 175 bbl. of oil over a period of 6 months before the well was finally abandoned. Thus far the thin Rosiclare horizon has made the only commercial well in the area.

Structure

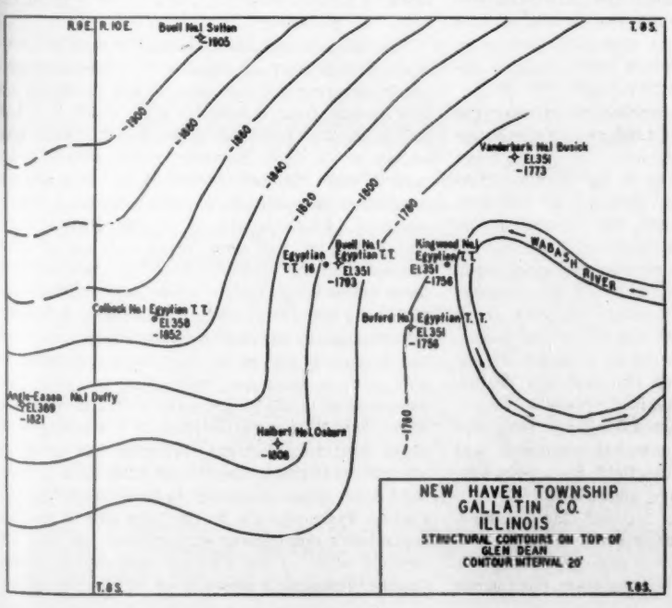
The accompanying structural maps—one drawn on the top of the Glen Dean formation, the other on the top of the Levias (the upper member of the Ste. Genevieve)—show that the structure of this area is probably pre-Chester in age. The contours drawn on the top of the Ste. Genevieve or Levias show that there is a structure along the west side of the township that has approximately 100 ft. of closure on the west side, and 53-ft. closure on the east. The large amount of structural drop to the west suggests the presence of a northeast-southwest trending fault with downthrow to the west between Angle & Eason 1 Duffy and Colbeck 1 Egyptian Tie & Timber Co. That faulting is present is more than likely as the Rough Creek or Shawneetown fault zone which crosses Illinois in an east-west direction to the south of this area is characterized by a series of northeast-southwest trending faults along the north side of the fault zone. It is perhaps one of these faults that cuts the anticlinal nose of the structure to give the 100 ft. of closure to the west.

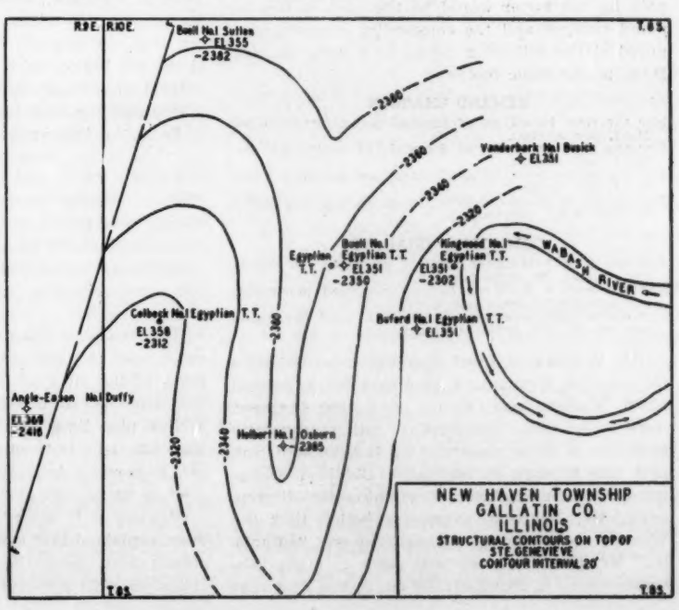
A study of the isopachs of this area shows that high point of the structure is probably in Section 19, and that the structure is broader to the south than to the north.

Production

The only commercial well in the area is D. C. Colbeck 1 Egyptian Tie & Timber Co. At the present time this well is producing from 200 to 300 bbl. from the Rosiclare (2,736-42 ft.). When shut in the well builds a casing pressure of approximately 300 lb.

The potential productive acreage is from 600 to 800 acres. With only one well producing, it is impossible to give an accurate estimate of the exact amount of acreage that will be productive. From an isopach map, which shows a thinning of 87 ft. in the interval between the Glen Dean and the Levias, from Halbert 1 Osburn to the Colbeck well, the crest of the structure is thought to lie in 19 and S½ 18-8s-10e.





Claim Panhandle and Hugoton Gas Reserves Ample to Supply Wisconsin Markets

MADISON, Wis., Nov. 12.—At the hearing conducted by Federal Power Commission and state regulatory bodies to consider applications for building natural-gas pipe lines to serve Wisconsin, testimony was presented by Natural Gas Pipeline Co. of America, Western Natural Gas Co., and Independent Natural Gas Co. regarding reserves, markets, and rates.

Natural Gas Pipeline, through Floyd C. Brown, its vice president and general manager, and E. V. Kesinger, general superintendent, presented no detailed schedules of rates and service proposed for the same Wisconsin communities as those in which the other two pipe lines contemplate service. It offered, however, to apply the rates now prevailing in Chicago, or to meet the rates of Western Natural Gas, which proposed schedules, on the basis of larger consumption estimates, considerably lower than those of Independent. For all gas delivered under the optional schedule monthly during the changeover period, it proposed that buyers in all communities pay 25 cents per M.c.f.

Subject to the Federal Power Commission's approval the company announced the same optional rate schedule would be available to any gas-distribution utility in Kansas, Nebraska, Iowa, and Illinois, subject also to the execution by such utility of a contract under the terms of which the distributing company would agree to purchase from Natural Gas Pipeline its entire gas requirements for a period of years.

Compute Rate

For all gas delivered under this schedule monthly after the changeover period, the amount to be paid by the buyer would be the sum of the demand charges and the commodity charges, computed at the following rates, on a basis of 1,000 B.t.u. to the cubic foot:

DEMAND CHARGES

For the first 10 cu. ft. of demand per capita, $40 per M.c.f. per annum.
For the next 10 cu. ft. of demand per capita, $30 per M.c.f. per annum.
For the next 15 cu. ft. of demand per capita, $20 per M.c.f. per annum.
For all gas in excess of 35 cu. ft. of demand per capita, $15 per M.c.f. per annum.

COMMODITY CHARGES

For the first 8 M.c.f. of natural gas used per capita per annum, 20 cents per M.c.f.
For the next 8 M.c.f. of natural gas used per capita per annum, 10 cents per M.c.f.
For natural gas in excess of 16 M.c.f. used per capita per annum, 9½ cents per M.c.f.

The Western Natural Gas Co. rate estimates for sales to distributors, compiled by J. Samuel Hartt, Madison and Chicago consulting engineer, were based upon consumption estimates greatly in excess of those presented by Independent Natural Gas through P. McDonald Biddison, Dallas gas consulting engineer. Explaining the discrepancy, Mr. Biddison expressed belief that the Western consumption estimates were "optimistic." Mr. Hartt forecast total sales, in eight Wisconsin cities, of 23,025,001,000 cu. ft. the first year and 50,972,602,000 cu. ft. the fifth year, at a rate of 20.88 cents a thousand for firm gas in Milwaukee and an average rate for all gas of 17.64 cents.

Mr. Biddison anticipated total sales of 12,422,751,000 cu. ft. in Wisconsin the first year and 36,364,395,000 cu. ft. the fifth year in 111 cities and towns covered in his survey and including dump-load sales to power plants and Fox River Valley paper mills. On this consumption base Mr. Biddison anticipated a distributor rate of 26.05 cents for firm gas and an average rate for all gas sold the fifth year of 22.87 cents.

Claim of the Western Natural Gas Co. that the Wisconsin market could be served better from the Hugoton field of Kansas, Oklahoma, and Texas than from the Texas Panhandle field, was based upon testimony of J. Harper McKee, New York geologist, and James H. Page, gas engineer and petroleum geologist for the Kansas State Corporation Commission.

Estimated Reserves

The evidence showed about 18 trillion cubic feet of reserves in the Hugoton field, from which withdrawals now total about 30 billion cubic feet yearly. Adding to this their estimate of 50 billion cubic feet marketed annually in Wisconsin it was computed that the total withdrawal of 80 billion cubic feet would leave a supply sufficient to last 200 years. The Hugoton field was estimated to contain about 2,980,000 acres, but Mr. Page testified that nobody knows its exact limits. The Panhandle field was estimated at about 1,475,000 acres.

While Dr. G. L. Knight, geologist for Phillips Petroleum Co., parent of Independent, and E. C. Turner, engineer, estimated the Panhandle reserves at 22.195 trillion cubic feet, it was pointed out that withdrawals from this field amount to about 639 billion cubic feet a year, giving a calculated lifetime of about 34.7 years.

Testimony placed the number of existing gas wells in the Panhandle at 1,652 and in the Hugoton field at 330. Panhandle wells have an average depth of 3,000 ft. and those in the Hugoton field 2,800 ft. Present reservoir pressure in the Panhandle was placed at about 340 lb. and in the Hugoton field 409 to 430 lb.

Witnesses based their reserve estimates upon the pressure-decline method. While the average pressure decline in the Panhandle has been about 90 lb., geologists testifying for the Western company, said the gas pressure in a given 260,000 acres of the Hugoton field had shown a decline only from 438 lb. to 409 lb. in 10 years.

Nine pipe lines now are taking gas from the Hugoton field, but none is a major concern, said Mr. Page, who declared the field has ample supplies to serve several major pipe lines.

Officials of Independent Natural Gas Co., however, explained that company plans to serve Wisconsin both from the Panhandle and Hugoton fields, 50 to 75 per cent to come from the former and the balance from the latter during the next 10 to 20 years.

The Phillips Petroleum Co., which will furnish the Independent's requirements, owns and controls 270,000 acres in the Panhandle containing reserves of 4.555 trillion cubic feet and 153,000 acres in the Hugoton field with estimated reserves of 929.9 billion cubic feet.

For the present it plans to draw upon 241 wells in the Panhandle field and to drill 50 wells in the Hugoton field, some in Kansas and some in Oklahoma. If the gas is taken from the Panhandle field, witnesses said, the plan would be to drill 17 wells there for the first year and increase the number as the demand grows.

Assures Adequate Supply

Don Emery, Bartlesville, Okla., vice president of Independent, and Edward Budress, its gas engineer, gave assurance that the company could supply the Wisconsin market for more than 40 years, assuming a maximum consumption in the state will reach 200,000,000 cu. ft. daily. It guarantees, Mr. Budress said, to supply requirements of the Wisconsin line for the first 20 years from reserves already producing and will dedicate 200,000 acres, containing a reserve of approximately 2 trillion cubic feet, to the system, adding a supply thus sufficient for at least 28 more years.

Mr. Turner said Panhandle reserves of 22 trillion, 195 billion cubic feet would give the field a life of approximately 50 years at the present withdrawal rate, but anticipated a decrease in future production, rather than an increase, because of proration laws and other conservation measures.

Similarly, Dr. Knight, crossexamined by counsel for the city of Milwaukee, was asked if there was any possibility that reserves in the Phillips acreage ever would become unavailable during the lifetime of the proposed Wisconsin pipe line.

"Enough wells have been drilled in the Panhandle and Hugoton fields, over a wide enough area, to indicate clearly a gas reserve of great extent," he declared.

The Western Natural Gas Co., through its president, Paul Kayser, El Paso, Tex., introduced contracts covering the purchase of gas in Oklahoma and Kansas, from companies with which it is not affiliated. The purchase price in Oklahoma was shown as 3.5 cents for sweet gas at a field pressure of approximately 420 lb. at the well and on a pressure base of 2 lb. above an assumed atmosphere of 14.4 lb. to the sq. in. Mr. Kayser computed that on the same pressure base as that contained in the Phillips Petroleum Co.'s contract these prices would be, for sweet gas in Oklahoma, 3.15 cents and for sweet gas in Kansas, 3.6 cents.

The price to be paid by Independent to Phillips Petroleum Co., as shown by the testimony, is 4.75 cents a thousand cubic feet for sour gas, measured at 14.735 lb. pressure, and 5.25 cents for sweet gas. Witnesses testified to a treating cost of ½ cent for sour gas, bringing the price of merchantable gas in the line to 5.25 cents a thousand. Both types of gas are to be delivered by the Phillips Petroleum Co. to the inlet side of the Independent's compressor station near the Ray absorption plant of the Phillips company in Moore County, Texas, at a pressure of 175 lb. per sq. in.

The American Petroleum Institute Can Answer Through Its Record

UNTIL the emergencies of national defense during the World War brought together oil men from all parts of the United States for the purpose of working toward a common goal, cooperation had been considered too much like the absence of competition in that young industry. As a result, in a business among the most competitive in the world, little thought had been given this means of correcting certain obvious evils. Each man or company was content to work out his or its own problems.

Twenty-one years ago, however, when the members of the War Industries Board on petroleum products prepared to close their Washington offices at the end of the war, some had misgivings regarding the advisability of this extremely isolated policy. In a series of meetings which followed, the American Petroleum Institute was born. The industry had learned that cooperation for the common good in many important matters in no way impaired private enterprise and competition.

Born in Adversity

Literally a member of the so-called "War Generation," the Institute has met and overcome all the obstacles which usually face that generation, with much more than usual success. Its childhood was spent in the reckless abundance of the twenties, its adolescence in the scarcity of the thirties, and it reaches legal maturity in 1940, with the shadow of another world conflict looming over it.

The history of the American Petroleum Institute is the record of the transition period during which the oil industry rose from a prospecting gamble to a scientific, mechanical business. The evolution was not slow. On the contrary, developments were apparent almost from the inception of the Institute. It was not without discouragements and low spots, however, due to the many obstacles encountered, both from within the industry itself, and from other sources.

● The American Petroleum Institute this year reaches its majority. This splendid trade association, the history, purpose and activities of which are reviewed in these pages, was born of the vicissitudes of one World War, and attains its maturity during the days of another world-wide conflict.

● Its history has been one of rich accomplishment. Its purposes are lofty. Its activities are ramified. The contribution the organization has made to the common good is incalculable. It is with genuine pride that we present this review, at a time when the organization is under attack and may be called upon to fight for its life.

● The strength of any trade association is found in the strength of the men who devote their time and intelligence to its welfare. The American Petroleum Institute is particularly fortunate in having as its leaders men of exceedingly high caliber.

● As this appears the industry is gathered in another annual meeting. This meeting may well be one of the most important the industry ever held. We feel that the general and technical sessions of this meeting will demonstrate anew the vital qualities inherent in the organization aims. They will be effective answers to the criticism being leveled at the industry and its largest trade associations.

● We also feel that while the Institute has reached its majority, it has not yet attained its full growth. This will continue on through the years, and many another important milestone will be passed as time goes by.

No more favorable commentary than the record of achievement of the Institute can be made of the oil industry and of the caliber of the men who represent it. Widespread distrust of the association through misinformation and ignorance was evident at the outset. Men in the field were slow to take advice or ask help from "pencil pushers," and executives were hesitant to adopt revolutionary changes which entailed large initial investments, despite the obvious advantages to be gained later. Manufacturers of oil-industry equipment were hostile at first due to equal short-sightedness.

Sought to Eliminate Evils

But the men who visualized the benefits to be gained from a strong centralized national-trade association within the oil industry, and encompassing every field of activity in that industry, were not easily discouraged. The proof of the wisdom in creating such an organization was evident in other, older industries which had matured to the point of discovering that excessive competition in all lines could be ruinous. These industries, through the medium of their national associations, had wrought changes and improvements which altered the whole character of the industry, only by virtue of exchange of ideas. Why, these oil men reasoned, if it was possible to improve coal, textile, steel and other big national industries through this means, could not the same end be reached in petroleum?

The federal administration, which sought, through judicial, rather than legislative, procedure to dissolve the American Petroleum Institute, endorsed the precept of trade associations through the medium of the Department of Commerce in 1937.

Defining trade associations as "voluntary organizations of business competitors, usually in one branch of the industrial, trade or service fields," the Commerce Department further stated that the aim of these associations is to "promote that branch through

AXTELL J. BYLES
President, A.P.I.

WILLIAM R. BOYD, JR.
Executive vice president, A.P.I.

cooperation in two or more of the following phases; accounting practices, arbitration, business and commercial research, public relations, statistics, and trade promotion."

From its conception to its present position as the largest single entity within the oil business, the American Petroleum Institute remained within these limits. It has been the oil man's association. Its story is the story of the oil man. All the discoveries, innovations, revisions, adaptations and myriad other benefits which have originated within the Institute have at once become the property of the whole industry. Ultimately, in an industry whose product is universally used, all these benefits have become the property of the nation and the world.

Work Invaluable

Actually, the evaluating of the work done by the Institute in cold figures is impossible. It would be impossible to calculate how many developments in methods or materials would never have been brought out of the laboratory if the inventor had not been given the advantage of hearing or reading technical papers on the same or allied methods or materials, through the Institute. The efforts in safety alone, translated into human suffering and lives lost would justify the existence of the Institute. Yet this is only one of many jobs undertaken by this association.

The men who struggled with the early growth of the American Petroleum Institute were able to foresee these results. They donated their work to the industry, taking nothing for the time spent in organizing, planning and executing, and in all cases, paying their own expenses to the meetings. The fact that their work was an important one, and of far-reaching importance, can be seen in a glance at the structure of the American Petroleum Institute today.

There are three major divisions, (1) Production, (2) Refining, and (3) Marketing, each attended by one general committee, a few central committees, and many topical committees. The general committee supervises the activities of the entire division, approves all reports, and has the power to make suggestions and recommendations to the board of directors. The central committees are devoted to problems in the different branches of activities affecting the division, and the topical committees' work on specific problems within these branches, submitting the results of their work to the central committee, which considers and takes action on their recommendations.

In addition to the divisions, there are departments, or special committees, whose work deals with branches of the oil industry not covered by the major divisions. These departments are: The American Petroleum Industries Committee, working on taxation; the department of accident prevention; the department of engineering; the department of public relations, and the departments of statistics, accounting, fundamental research, and cooperating with other organizations.

In each of the divisions, departments, and committees during the annual and semiannual meetings of the Institute technical papers are read and exchanged, thus permitting a dissemination of the information concerning all new adaptations of old methods or machines, and the invention of new ones. The outstanding papers read are selected, published in book form, and distributed for use as reference books. In this respect the Institute acts as a forum for the entire industry, a service which could not be performed by any other than a strong national association.

Without doubt one of the most important activities undertaken by the Institute since its beginning is the standardization program, directed by the central committee for standardization of oil-field equipment, in the Division of Production.

The standardization programs of the Institute's Divisions of Refining and Marketing, under the direction of Dr. R. P. Anderson and D. V. Stroop, respectively, have undertaken valuable work in their respective divisions.

In the Division of Refining, the obstacle to greater standardization has been the complexity of the problems met. The standardization program in this division has been confined largely to valves and their fittings, and tubular goods, and even in these elements, the accent has been on quality specifications, rather than on interchangeability. Working margins of pressure and temperature in pipes and vessels have been established by the committee which acts in this capacity.

In the Division of Marketing there is little opportunity, or necessity, for standardization of dimensions, other than on gasoline pumps, grease-measuring and other measuring devices. Most of this work in the Marketing Division has been carried on in cooperation with the National Conference on Weights and Measures.

The standardization program of the Division of Production, the first successful attempt at nation-wide interchangeability of oil-field equipment and tubular goods, was sponsored at the meeting of the Institute at St. Louis in 1922 by the then president, Thomas A. O'Donnell. In presenting his argument, Mr. O'Donnell pointed out that the average operator knew almost nothing about the materials he used, and drew attention to the fact that there were over 20 different grades of steel used in manufacturing pipe.

Prior to the standardization program the development of oil-field equipment, structural, mechanical or tubular, was largely a matter of the individual in each case adapting tools to the problem at hand. Due to the complete lack of interchangeability of parts at that time, there had been no well-defined efforts made to increase the quality either of the product or of the material used in making it. The ability of these rugged individualists who made up the personnel of the early oil industry to meet the increasing demands for their products without adequate tools stood them in good stead. Money and time were lost, however, due to the unwieldiness of the situation, and change was inevitable.

One of the leaders of the standardization movement of the Institute is Carl A. Young, secretary of the Production Division of the A.P.I. A part of the program from its beginning, Mr. Young is actively engaged in the work at present, operating from the Institute offices in Dallas, Tex.

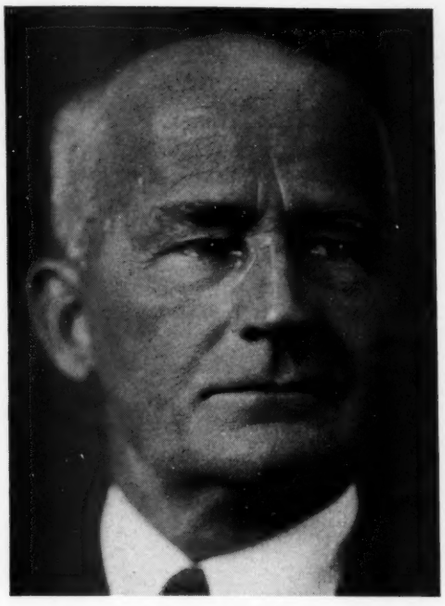
Leader in Standardization Work

"In reflecting credit for the work done by the standardization committees of the A.P.I.," Mr. Young states, "the Tulsa Purchasing Agents Association must be given a large share." This organization, and the Mid-Continent Oil and Gas Association were active in planning standardization of oil-field and refinery equipment as early as was the Institute.

Among the individuals largely responsible for the work which has been accomplished is J. Edgar Pew, vice president of Sun Oil Co., who could be termed the father of standardization in the oil industry, at least with regard to the production branch. In 1920 Mr. Pew was active in this work, serving as chairman of a committee of the Mid-Continent Oil and Gas Association, attempting to standardize oil-country tubular goods in the Mid-Continent area. With the inauguration of the Institute's standardization program in 1923 he was appointed chairman of a committee of the Institute to continue his work in the tubular-goods field on a national scale. With the organization of the central committee for standardization of oil-field equipment in 1924, he was given the chairmanship of that committee, and in November of that year was elected president of the American Petroleum Institute for 1925. While president of the Institute, Mr. Pew continued as chairman of the central committee on standardization, which post he still holds. In 1937 he was presented the first Lucas award by the American Institute of Mining and Metallurgical Engineers for "distinguished achievement in improving the technique and practice of finding or producing petroleum."

John R. Suman, vice president of the Humble Oil & Refining Co., who succeeded Mr. Pew as national chairman of the committee on standardization of oil-country tubular goods in 1929, has also been identified with the standardization movement since its beginning. As chairman of this committee, Mr. Suman has in the past played

JOHN R. SUMAN
Active in A.P.I. standardization work



J. EDGAR PEW
Father of standardization. A.P.I., president, 1925

CARL A. YOUNG
Secretary A.P.I. Production Division

and is now playing an important part in maintaining the equilibrium of tubular equipment through the revolutionary changes which have been taking place in threads on casing and tubing.

T. E. Swigart, vice president of Shell Oil Co., Inc., and national chairman of the committee on standardization of pumping equipment and engines, is another who has pioneered this movement. Mr. Swigart has actively taken part in standardization work since the inception of the program in 1924, and has held his present post since 1927.

A. H. Riney, vice president of Phillips Petroleum Co., still retains his chairmanship of the national committee on standardization of belting, to which he was appointed at the start of the program in 1924.

The first step taken by these men, and the others who envisaged the benefits to be reaped from the program, was "simplification," a reduction in the tremendous number of sizes of threaded joints, tanks, derricks, pumps and other material necessary to the production of petroleum. Within 5 years equipment companies were able to reduce their units in stock by a ratio of 30 to 1. Supply houses no longer found it necessary to stock 50,000 items in order to carry on business as they had before the committee began its work.

After accomplishing simplification, the committee turned to the important task of interchangeability. As a result of their efforts there are available today A.P.I. specifications on every important piece of equipment used in the field. These specifications cover all tubular goods, such as casing, tubing, drill and line pipe, as well as pumps, rods, cable-tool joints, rotary-tool joints in both regular and full-hole and boiler fittings. In addition, interchangeability has also been achieved on derrick bases and crown-block openings, rig irons, engines and clutch connections, shafting, keys and keyways, sheave grooves for wire rope and cordage and pull rods. This means that there is no important structure for use in the field which cannot be built with parts from different manufacturers. This interchangeability does not confine itself to the borders of the United States. It is possible to purchase the component parts of a rotary-drilling outfit from manufacturers located in France, Germany, Italy, Canada and Rumania, assemble them as a complete rig, and have interchangeability on all essential threaded parts and all other important main connections. The committee has been careful not to interfere with designs of complete units such as slush pumps, rotaries, engines or swivels. Many of these, however, are interchangeable on major connections.

In addition to specifications as to dimensions, the A.P.I. has applied the standardization program to the quality of equipment. Such products as belting, boilers, derricks, pipe and casing, wire and manila rope, riveted and welded tanks, flanges and flange unions and drilling-through valves all have quality as well as dimensional specifications.

It was once suggested that since the Institute had achieved standardization, it was time to disband the committee. Nothing could be farther from the truth. Standardization is always dynamic, never static, especially in an industry such as oil. Increased depth of wells has necessitated constant improvement of thread form. Developments are constantly arising which make a continuous program essential. This could be called a refinement program, supplementing the original standardization program.

Specifications Watched Closely

The method by which the Institute carries on and maintains its specifications as to dimensions is through the use of gages and master gages. In the case of tubular goods, each pipe manufacturer, if an A.P.I. licensee, must have in his possession these gages tooled to the Institute's specifications, and which have been double-checked for accuracy by the federal Bureau of Standards, at Washington. Additionally, these gages, even if never used must be checked every 3 years, and if used must be checked every year. In the case of English or German licensees using the gages, the National Physical Laboratory of England, or the Physikalisch-Technische Reichsanstalt of Germany (both corresponding to the U. S. Bureau of Standards) must act as the check or testing agency. This provides for a disinterested third party to check the ability of the licensee to meet the Institute's specifications. An example of the efficiency demanded by the A.P.I. is the fact that negotiations were in progress for almost 2 years before licenses to test gages were granted to Germany's Physikalisch-Technische Reichsanstalt, despite that nation's recognized superiority in precision metal work.

Prior to standardization of pipe threads there were no master gages for use in checking the correct size of the threads, and these were adopted in the earliest stages of the movement. Special instruments have been developed to answer the need for accurate testing of each thread factor, such as taper angle, height and lead. This development of special instruments is made necessary by the fact that a master gage cannot detect and classify errors in the individual thread elements. It simply shows the thread does not answer all the specifications.

A complete inspection of an A.P.I. pipe gage includes the following checks: (1) Length of gage; (2) position of gage point with respect to large end of gage; (3) pitch diameter at the gage point; (4) taper; (5) major diameter of plug gage, and minor diameter of ring gage at gaging notch; (6) pitch or lead (in A.P.I. gages, pitch and lead are identical—being equivalent to the axial travel in one turn); (7) examination of thread form for (*a*) smoothness of surface; (*b*) straightness of sides of thread; (*c*) clearance at root; (*d*) concentricity of pitch and major or minor diameters of plug or ring gage, respectively.

A specific summary of the standardization program and its results during recent years in the different phases of the work will give the reader an idea of the significance of the work undertaken and accomplished since the first long corrective steps were taken.

BELTING: A.P.I. quality dimension specifications originally, and now, cover six types of material used in the manufacture of belts. These are leather, stitched and solid-woven cotton, hair, balata and rubber. Additions have been made in specifications on cord and V-belts, while testing stipulations have been codified showing form for reporting tests.

CABLE TOOLS: Early issues of cable-tools specifications of the A.P.I. covered 11 sizes of joints with seven threads per inch, and included very few details on master gages or the recommended practice in turning threads. Dimensional specifications on three additional small sizes of tools with eight threads to the inch are available. The gage stipulations have been amplified

giving complete details for the checking, care and use.

DERRICKS: The specifications originally covered four sizes of wood and steel combinations, with 11 sizes of steel having two series of bases. This was intended to provide derricks with a uniform taper to the sides. Today, with the uniform taper series discarded there are nine sizes of steel and eight sizes of wooden derricks. Values of permissible unit stresses, and formulas for computing the sizes of members, with limiting safe load capacities, have been added. Other new features include standard connections for headboard and calf-wheel parts, as well as detailed designs for superstructure.

RIG IRONS: The first A.P.I. stipulations with regard to rig irons reduced to three the number of sizes, eliminating three other sizes then in use. Of the 28 sizes of sand reels then in use, 23 were discarded. Rig-iron cranks and shafts had been standardized in three sizes—one length for the 4½-in., two lengths for the 5-in., and two lengths for the 6-in. shaft. Now there has been added another shaft length for the 6-in. size, and the 7-in. size has been adopted with two shaft lengths.

ROTARY EQUIPMENT: Early Institute specifications covered seven sizes of regular rotary taper joints, with dimensions on fish-tail bits, drill collars and grief stems. Now there are additional sizes covered—one regular tool joint, five sizes of full-hole tool joints with couplings and subs, integral-thread grief stems, and swivel connections; specifications have been also made for mud hose, brake blocks, and dimensions on the fluid end of piston rods for slush pumps. The Institute has issued a special bulletin, explaining the use of external-upset, internal-flush drill pipe.

WIRE ROPE: Additions to the original three grades of wire rope have been made, including specifications on torpedo lines and well-measuring lines.

PUMPS: Originally the specifications on pumps covered only cold-drawn and machined liner barrels and couplings for tubing-type pumps, wherein the barrel is run into the well on the tubing. To these have been added the rod, or inserted-type pump, which complete with barrel and all inner parts are attached to the sucker rod and run through the tubing. As a result the single original 15-page specification has grown to five specifications totaling 150 pages. A revised specification, under one cover, containing a new method in presentation of data, is in process of completion.

SUCKER RODS: The sucker-rod specifications have been expanded from coverage of three sizes to five, and now include complete details for retesting sucker-rod gages.

TANKS: At this time the Institute is contemplating a change in its tank specifications to include all-welded tanks. The purpose is for flexibility of size, with resultant greater efficiency. There need be no size requirement on welded tanks.

For riveted tanks the specifications have increased from design details of major importance, to include construction drawings for seven diameters of tanks, plus major design details for four smaller sizes. In addition specifications are now available on a complete series of bolted production tanks.

TUBULAR GOODS: An important development is taking place at present in the A.P.I. thread specifications. Rather than two different forms of thread, work is progressing on a single form (8-thread, ¾-in. taper) which will eventually be adopted as standard for casing, some sizes of tubing, and drill pipe.

Continuous Progress

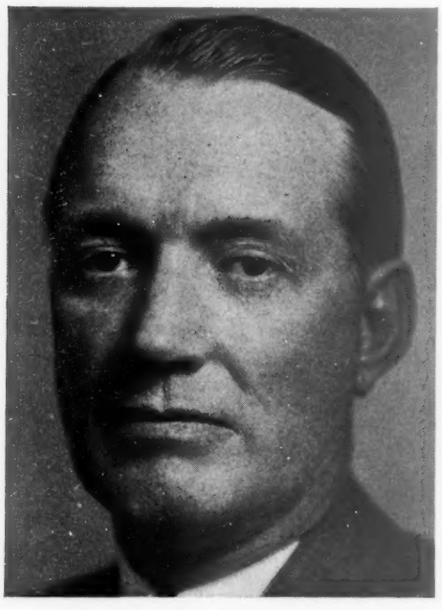
This particular branch of standardization work is continually subject to revision due to progress. As result of complaints of leaky joints in A.P.I. pipe threads, tests have been made recently using three different forms of threads, one the usual Brigg's sharp thread; the A.P.I. drill-thread form, now known as the round thread, and a modification of the latter, with slightly greater thread height. The information made available by these tests indicates that the round thread will be adopted comprehensively as more efficient for oil-field use, especially today, with pressures increasing. It is already standard for tubing, and has been tentatively adopted for casing. In the meanwhile, the standards on the old sharp thread will be retained for the purpose of covering any pieces of that type which may be in use.

The estimated cost of producing the A.P.I. Standards Handbook, based on the time and traveling expense of the committee members, has been placed at $2,500,000. It is obvious that the equivalent in experience, ability and cooperation could not be hired at any figure. The work is done through voluntary donation by the ablest and most experienced men in the oil industry. This book is made available to the industry.

The standardization program of the Institute has broadened the scope of its activities steadily since its beginning, until now it contains 10 separate committees, each dealing with a separate division of the work. The total number of committee members—694— is divided to include 515 users, or operators, and 179 manufacturers. The annual issue of revisions and additions to the specifications is sent to 1,800 subscribers, of which 350 are foreign.

An estimate of the value of this part of the activities of the American Petroleum Institute, conservatively placed in money saved the industry per year, is $15,000,000. This saving, passed on to the consumer, represents valuable service to every person in the country. The use of petroleum products is so closely interwoven into the daily life of today that its significance is sometimes lost. Yet, every citizen of the United States, regardless of whether or not he is an automobile owner, has a large stake in the savings represented here.

In commenting on the work of the standardization committees, E. De Golyer, internationally recognized authority on geophysics, and professor of geology at the University of Texas, said: "The greatest and possibly most important improvement in drilling technique from the viewpoint of the prospector, has been the constantly improving ability to achieve increasingly greater depths . . . A consideration of . . . well depth, and some acquaintanceship with the technique of drilling suggests that increasing depth has come about as a result of better material, equipment, and greater power, rather than from any fundamental change in design. In the opinion of the writer, the standardization of drilling equipment program of the American Petroleum Institute has been one of the greatest single factors in contributing to this condition."



BAIRD H. MARKHAM
Director, A.P.I.C.

T. E. SWIGART
Chairman, pumping and engine standardization

LACEY WALKER
Secretary and assistant treasurer, A.P.I.

Disproportionate Taxes Fought by A.P.I.C.

THE American Petroleum Industries Committee was created by the American Petroleum Institute on November 16, 1932, for the purpose of maintaining a constant watch, and if possible, a check, on the rapidly growing number of disproportionate taxes and other forms of legislation seriously handicapping the oil industry.

The rapid progress of refinery methods, lowering of transportation expenses, reduction of expense through standardization and interchangeability had, in recent years, brought down the price of gasoline to almost half its cost immediately following the World War, yet the reduction in price to the consumer had not been made accordingly. Excessive taxation of this product was, in 1932, at the point of strangling the oil business in the midst of unparalleled economic depression. In retrospect it is not surprising that the industry should have been slow to take steps to prevent further progress of the taxing program of federal, state and local governments.

When, on February 25, 1919, the State of Oregon imposed a tax of 1 cent per gallon on all gasoline sold, the public and the oil industry alike approved the measure. The automobile industry had progressed, with the impetus of the war, through the "horseless carriage" era into practical production of motor vehicles for commercial and private usage. The public wanted better roads for its new and somewhat rough-riding cars and trucks. The oil industry visualized the benefits to be gained from increased motor travel, and lent its support to the tax. Both public and industry were agreed that this was a fair and equitable means of financing the necessary, adequate roads and highways.

Revenue-hungry legislatures were quick to sense this approval, and within 7 years the gasoline tax had been adopted in every state in the country. In subsequent years the possibilities of the gasoline tax became more and more apparent to politicians. Gradually, larger burdens were place on the industry, which managed, through improvements, to lower the price of its products, and more than assume the addition.

Thus, through the attitude of the oil industry itself—an attitude of generosity based, primarily, on the belief that the world was on the verge of permanent prosperity—legislatures came to look upon gasoline-tax revenues as general income. No longer was it considered a special additional tax, and its original purpose, financing roads and highways, was forgotten in the ensuing rush to board this convenient "bandwagon." From an income viewpoint, gasoline tax is ideal. The volume is enormous, and the collections are made easily, at the time of purchase. Additionally, it was termed a "class tax," working on the assumption that motorists were able to buy automobiles, hence were above the average income bracket. Recent statistics point out that the average motorist's income is slightly less than $30 a week.

All the usual fellow travelers of high prices accompanied the disproportionate gasoline tax into the oil industry. Bootlegging and substituting inferior products at lower prices, with tax evasion, aided in crumbling fair prices and, in many cases, brought about the destruction of whole markets. The loss to the industry in public opinion alone is inestimable, as, due to misinformation, the public placed the blame for irregular prices on the industry.

This discouraging outlook faced the American Petroleum Industries Committee in 1932 when it started its program under the direction of Baird H. Markham.

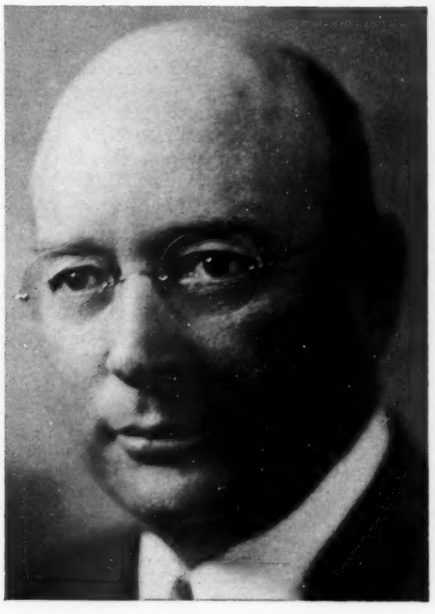
"We had," Director Markham said in reviewing the committee's activities at the Institute meeting on November 16, 1939, "little more than a plan and a program. We were a loosely knit group, functioning on an emergency basis in an attempt to work with a largely uninformed industry which was trying to save itself from becoming entangled hopelessly in a network of hastily conceived tax legislation that frequently was ill-advised, and almost always hastily enacted. Panaceas were the order of the day. To cope with the hundreds of measures introduced during the 93 regular and special legislative sessions which were held that year on the one hand, while perfecting an organization on the other was, to say the least, a strenuous assignment."

The specific activities with which the Industries Committee deals, and the objectives which it attempts to reach are:

1. To give aid to the strengthening of all state gasoline-tax laws, so that evasion of taxes, and substitutions may be prevented.
2. To oppose further increases in gasoline taxes.
3. To adhere to the principle that funds derived from gasoline taxes should be spent only for highway construction and maintenance.
4. To advocate reduction of gasoline taxes that are disproportionately high.
5. To oppose unreasonable restrictions upon the operation of motor vehicles.
6. To urge that taxation of petroleum products be left solely to the states.
7. To oppose all legislation inimical to the best interests of the petroleum industry and highway users in each state.
8. To combat gasoline-tax evasion by coordinating the committee's efforts with those of state and county tax-collection officials, and/or whatever other agencies are concerned with this problem.
9. To adopt a program of public relations which will assist in fostering and securing the legislative objectives outlined.

At no time has the Industries Committee organization resembled a "lobby." The committee merely serves as a means for expediting the rights of the petroleum industry, its personnel and consumers, as citizens. It provides a medium through which they are able to voice, with the added effect of organization, their opposition to undue taxes, or any form of burdensome legislation imposed upon them. In no case has the committee aligned itself with any particular party, faction or candidate, which is in keeping with its noncontroversial character.

THOMAS A. O'DONNELL
First A.P.I. president 1919-20-21-22-23-24



W. S. FARISH
A.P.I. president 1927

E. B. REESER
President 1929-30-31

limited in activity to tax and legislative matters.

The structure of the committee consists of a national office, operating under the director, and acting as a service organization. Its duties are to assist state and local committees and cooperating organizations in carrying out their programs. It makes available for these committees, educational data, publicity material, and suggests plans for organization as they are observed.

Due to the size of the area which must be covered in the United States, the country has been divided into seven geographical parts, each of which encompasses from 2 to 11 states. In each state a large general committee is appointed, which covers all phases of the industry, and from it are selected the necessary subcommittees. In each state there is one full-time secretary.

An idea of the volume of work undertaken by these state groups, their committees and subcommittees, can be gained from a review of a part of their activities. A year-to-year account of their efforts with regard to gasoline taxation and diversion matters alone reveals the amount of legislation which must be combed.

First Year's Experience

During 1933, the first complete year of operation by the committee, there was a total of 110 bills affecting gasoline tax rates, introduced into the various state legislatures in session that year. Of this number, 80 would have increased, or reenacted the old rate, while 30 were designed to reduce the rate. Of all these only one, in Oregon, was enacted increasing the rate, while Idaho and Arkansas abolished the tax on aviation gasoline. During the same year over 285 bills were introduced aimed at diversion of the revenues derived from gasoline tax for purposes other than the construction and maintenance of highways and roads. Of these, 6 states succeeded in diverting gasoline taxes to school funds, 7 to retire bond issues, 2 to pension funds, 12 to the general fund, 11 to relief funds, and 5 for miscellaneous purposes. Additionally, constitutional amendments providing for diversion of this tax in California and Missouri were defeated. Throughout this year there were 2,437 bills introduced into state legislatures which in some way affected the oil industry, directly or indirectly. The committee undertook to examine each one for possible impediments to the industry, and wherever these impediments were detected, action was taken. Of primary importance in this type of work is the educational value of these campaigns to the public, which are given wide publicity.

The year 1934 was a so-called "off year" in state legislation, as only nine states held regular sessions, but 23 states held 30 special sessions. A large number of bills, considering the brevity of the sessions, were introduced, but only New York and Ohio reenacted bills maintaining emergency rates on gasoline tax. Colorado and Arkansas succeeded in enacting bills providing for higher tax rates, out of a total of 24 proposals made in 16 states. Despite strong opposition, nine of the 64 bills designed to divert gasoline-tax revenues were passed that year, with schools, relief, and general funds being the principal recipients.

The year 1935 marked the first evidences of the rising trend of Government to supervise and control business. The social-security program was begun that year also, and the efforts at reduction of property taxes, after study by the committee, seemed to indicate attempts to broaden the tax base generally. Regular sessions were held in 44 states, and 22 special sessions were called in 17 states, of which two were considering specific problems not dealing with or affecting the oil industry. Other than the favorable legislation enacted, significant was the memorial, adopted by 12 states, requesting Congress to allow the federal gasoline tax lapse on June 30, 1935. Additionally, sales-tax laws, incorporating an exemption for petroleum products were passed in Colorado and New Jersey, while filling stations were exempt under chain-store laws adopted in California, Florida, and Texas. Laws indirectly affecting the industry were enacted favorably in five other states. On the unfavorable side of the picture were increases in gasoline-tax rates in five states, and continuing of emergency higher rates in five states. Six states passed laws permitting diversion of motor-tax funds, and in Maryland a law requiring oil companies to pay traveling expenses of state auditors at certain times was enacted.

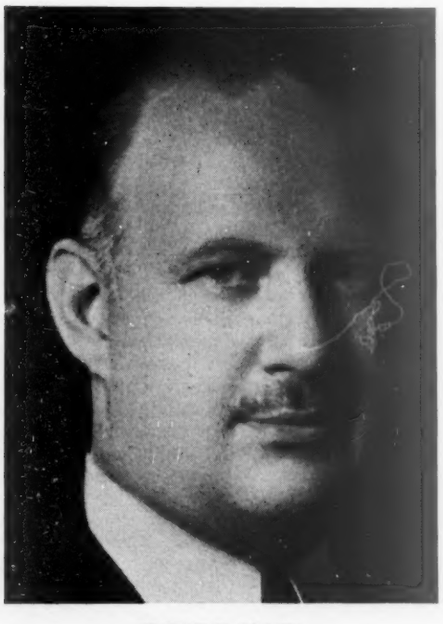
During 1935, 54 state legislatures convened, 9 regular and 45 special sessions meeting for the chief purpose of matching federal allocations to various state governments. Kentucky and Alabama legislatures adopted memorials requesting Congress to discontinue the federal gasoline tax. New York reduced its state tax by 1 cent, and added a retroactive refund law to handle payments made in error. In Alabama a bill was passed revoking a previously granted county privilege for levying a 3-cent gasoline tax, and in Massachusetts a law relating to licenses for the storage of petroleum products, granting relief to about 95 per cent of the companies maintaining such facilities in the state, was enacted. Less favorable were laws providing for diversion, enacted in six states, and a lubricating-oil tax enacted in Louisiana. Emergency gasoline taxes were continued in two states, while the emergency 1 per cent automobile titling tax was continued for 1 year in Maryland.

Success Attends Efforts

Over 7,000 bills directly or indirectly affecting the oil industry were proposed in 1937. Of this number there were only five 1-cent increases in gasoline tax, and only one of those was made permanent. Legislation prohibiting county and municipal taxation of gasoline was enacted in Florida. Legislative approval of measures proposing constitutional amendments prohibiting diversion of motor taxes was given in four states, and antidiversion laws were passed in four states. At the end of 1937, 19 states made no diversion of the gasoline-tax revenues, 28 states no diversion of registration fees, and 14 states did not divert any of the motor taxes. A decline of more than 13 per cent in diversion was noted in this year—the first since 1929. Chain-store taxes were repealed in one state, and petroleum products exempted in two others.

There were no increases of state gasoline taxes in 1938, although five legislatures considered such measures. New York and Massachusetts continued their 1-cent emergency taxes, and Rhode Island passed legislation making its 1-cent emergency tax permanent. Illinois adopted a measure which permitted Chicago to divert $2,500,000 of its 1938 gasoline tax for relief purposes, with stipulations providing for eventual repayment of the money, these payments to be made from reduction in the existing diversion to schools. The legislation provided that these diversions be stopped eventually. Kentucky and New Jersey passed laws permitting diversion, the former for the purpose of advertising the state at the New York World's Fair, and the latter for relief purposes.

During 1939, of the 29 bills providing for increased gasoline taxation proposed in 15 states,



VICTOR H. SCALES
Director, A.P.I. public relations

R. P. ANDERSON
Secretary, A.P.I. Refining Division

FRED VAN COVERN
Director, A.P.I. Department of Statistics

only two finally became law. One, in Idaho, was in form of a 1-mill per gallon license tax, while North Dakota increased the gasoline tax from 3 to 4 cents for a period of 2 years, in order to match federal highway allocations. Further indication of the unfavorable public opinion regarding gasoline tax was the repeal of the city of New Orleans municipal tax. Five state legislatures resolved to submit to the electorates constitutional amendments which would outlaw the diversion of motor taxes, and diversion bills failed in eight states, while Maryland abolished all diversion.

In addition to these activities of checking the amount of unfavorable legislation with respect to disproportionate taxation, the state committees have other functions. They aid in protecting the state against gasoline-tax evasion and bootlegging, examine into the exemption and refund cases which fall within their districts, watch natural-gas taxation and other legislation affecting crude oil, pump and service-station licenses. Taxes on intangibles and tangibles come under their scrutiny, also bills presented which affect highway safety are supported or opposed according to the committee's decision.

According to a statement by Director Baird H. Markham, the dollar value of the American Petroleum Industries Committee, both to the industry and to the consumer, would be impossible to calculate. The thousands of campaigns carried on by the different state and local committees, all working without pay, have resulted in the defeat of countless disproportionate taxes and other legislation inimical to the interests of the industry.

The headquarters staff looked forward to 1940, an "off year," with Congress and only eight legislatures scheduled to convene regularly, as an opportunity to increase the nation-wide organization which they have already set up. At present there are 37 state committees, including District of Columbia, completely organized, with 278 district committees, and 2,373 county committees organized, covering 2,401 counties. Additionally there are 26 city committees organized.

This far-flung, complex network is a tribute to the following men who opened the work in 1933 as the first committee of the American Petroleum Industries Committee: Harry T. Klein, Texas Co.; Edwin S. Hill, Standard Oil of New Jersey; W. J. Guthrie, Gulf Refining Co.; Ray T. Osborn, Sinclair Refining Co.; James T. Cosgrove, Continental Oil Co.; W. A. McAfee, Standard Oil of Ohio; Paul M. Gregg, Union Oil Co. of California; and George V. Holton, Socony-Vacuum Oil Co.

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Accident Prevention Is Aim of Division

THE Department of Accident Prevention of the American Petroleum Institute performs an important work for the industry, functioning as a clearing house for information, and acting as an advisory board or correlating agency for the safety departments affiliated with it.

As early as 1927 the Institute recognized the benefits to be derived from an accident-prevention program, both in actual economies due to less time lost per job, and lower insurance rates, as well as the advantages to the worker in the field. Accordingly, H. N. Blakeslee was employed by the Institute, and placed on the National Safety Council, acting as secretary of the Petroleum Division of this organization. For 3 years Mr. Blakeslee remained with the National Safety Council, moving to the A.P.I. offices in New York, when the Institute created its own safety department.

In its function as an advisory board for the industry, the department appoints committees annually for the purpose of disseminating information to the three divisions of the Institute. Twice a year these committees meet, discuss developments of the previous 6 months, and prepare for publication accounts of outstanding discoveries. This work guides the secretaries of the committees in their recommendations to members.

The activities of the committees under the three different divisions of the Institute are separate, working on problems concerned directly with that division of the industry to which they are assigned. Despite the fact that there is no dovetailing of work, there is sufficient interest in all branches of the work to warrant an informational service between these committees.

One of the chief responsibilities of these committees is the Institute's Accident Prevention Manuals which cover the various phases of safety work. These manuals are compiled first in rough form, and submitted to the members of the committees, who make recommendations of what they feel should go into the complete publication for distribution to the industry. After careful editing by members of the committee, the drafts are handed on to the general committees of the division who finally pass on them.

Provide Useful Information

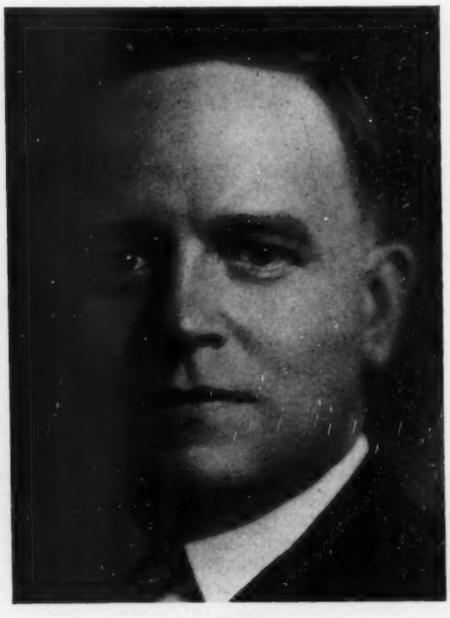
The eventual use of this material enables safety engineers to provide operators with the necessary information to finish their jobs with a minimum of lost time or damage to equipment. The department has also been helpful to many other industries, judging from the large number of requests received for these manuals from universities and libraries.

The department also handles many specific problems which occasionally arise within the industry, and which are not taken care of in the manuals. An example of this work is a confidential report of the contamination of kerosene by gasoline vapors, which caused a number of companies to alter their distribution practices with regard to these items. Additionally, there are certain government reports which are read and circulated by this committee. "Occupation Hazards, and Diagnostic Signs," published by the U. S. Department of Labor, are sent to the committee members.

Another important publication of the committee is the Accident Prevention Information news let-

DAVID V. STROOP
Secretary, A.P.I., Department of Engineering

H. N. BLAKESLEE
Director, A.P.I. Department of Safety



J. S. COOKE
Assistant secretary of the A.P.I.

ter. This bulletin is published once a month, and contains brief items on situations which have occurred, causing accidents. The importance which certain companies attach to this publication is made evident by the fact that in some cases one member may request as many as 150 copies for distribution to safety engineers. The annual distribution amounts to substantially more than 25,000 copies.

In the publication dealing with Annual Summary of Injuries to the Petroleum Industry are contained figures which draw comparison to the present standing of the oil industry with regard to other industries. The frequency of disabling accidents, the publication points out, was in 1927, 39.14 injuries per 1,000,000 hours worked, while now the rate is slightly less than nine lost-time accidents in each 1,000,000 hours. The savings in reduced rates of insurance alone of this work would be enormous while the time, equipment and money saved on the actual job is inestimable.

The committee also puts out a Review of Fatal Injuries in the Petroleum Industry, the twofold purpose of which is to furnish information on the causes of fatal injuries to oil workers and to aid in the correction of mechanical faults and situations which may result in these injuries.

Mr. Blakeslee in the course of his work in this phase of the Institute's activities, makes personal talks to the safety engineers of different oil companies, and attends conferences of committee members in different parts of the country. In this way the Department of Accident Prevention somewhat resembles an actively functioning safety department, rather than its original purpose as adviser.

Finally, the Department of Accident Prevention conducts a couse based on a study of the U. S. Bureau of Mines first-aid manual. The department approves the men employed by companies who instruct the classes in this subject. At the completion of one of these courses, the student is issued an A.P.I. first-aid card. This responsibility for training men in industry in the elements of first aid normally is the job of the Bureau of Mines. The extent of the work which must be done in the oil industry, however, is so great that the Institute's program is a necessity.

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Public Relations Broad

THE Public Relations Department of the American Petroleum Institute, directed by Victor H. Scales, is a necessary, integral part of the work of each committee in the comprehensive setup of the Institute. As the dispenser of information to the thousands of persons or companies which request it, both relative to the Institute itself and the industry, the history, activities, and statistics all must pass through the hands of this department.

As a means of publicity, the department makes and maintains contact with the press, operates a press room at annual and semiannual meetings of the Institute, and has, in some years, succeeded in getting more than 2,000 columns regarding the industry into newspaper and trade-journal print. Perhaps its most important work is as an educational facility for the public. It is the important responsibility of this department to correct mistaken public opinion about the industry, and to keep this same public opinion on a favorable plane.

All publications issued by the various committees of the Institute are handled by this department, which edits, proofreads, and prepares for publication the final form of the material. The public relations advisory committee, under the chairmanship of Northrop Clarey, of the Standard Oil Co. of New Jersey, cooperates with the department in matters of policy.

The Public Relations Department devotes a large portion of its work to the publication of regular organs, such as the Daily Oil Digest. This bulletin is sent weekly to a list of subscribers, and contains condensed information, gathered from newspapers and trade journals dealing with oil and allied industries. Among the regular publications is the Weekly Press Release, which is sent to publishers in all parts of the world, containing news and educational features dealing with the whole oil industry. Certain of the publications released by this department are solely for the trade press and house organs of the industry.

In cooperation with the American Petroleum Industries Committe, the Department of Public Relations releases enlightening matter dealing with legislative control of the industry through taxation. The Gas Tax News, published to this end, has a circulation of nearly 200,000 through the columns of the different journals to which it is sent.

Petroleum Facts and Figures, an important publication of the Institute, is handled by this department, and many of the booklets published are in constant demand several years after their original issue, necessitating continual revision and editing. "What Makes the Old Bus Go." a pamphlet put out several years ago, is a good example of this continuing demand.

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Statistical Data Helpful

UNDER the direction of Fred Van Covern, the Department of Statistics of the American Petroleum Institute furnishes valuable service in the form of figures and data not available elsewhere, in addition to condensation of certain government reports, highlighting their significance to the industry.

In its Weekly Statistical Bulletin, this department disseminates information to all parts of the oil industry. With regard to production and refining, the department publishes crude runs to stills each week, the crude-oil production estimate, finished and unfinished gasoline stocks, gas and fuel-oil stocks, cracking capacity, cracked-gasoline production, crude and refined imports to the United States, and their ports-of-entry receipts. In addition, this department makes public in monthly and annual digests the reports of the U. S. Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

For the information of the transportation and marketing division of the industry, the Bulletin includes figures on receipts of California crude and products at Atlantic and Gulf ports, monthly summary of gasoline consumption by states, and a quarterly motor-vehicle registration by states.

Facts of significance concerning developments in the oil industry all over the world are compiled and published in the Bulletin, and the department makes regular contributions to the Institute's Quarterly in the form of prepared papers. These papers deal with topics of current interest, as well as presenting the new and important advances of the industry.

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Experience and Ability Chief Institute Assets

IN summing up the functions of the American Petroleum Institute, and its value to the industry, it can be stated that there exists no other entity within the oil business which could have purchased even a fraction of the ability and experience which this association has been able to furnish. Through means of voluntary cooperation, the outstanding men in each department of the industry have placed their time and brains, so to speak, at the free disposal of the entire world, accomplishing ends, the most generous estimate of which may only be partly correct.

Under the auspices of the American Petroleum Institute, the outstanding engineers in production, refining, transportation, and marketing have contributed to bring the price of gasoline from 29 cents per gallon less tax, which was the prevailing price when the Institute was formed, to 13 cents less tax, at the present standard. The public, when purchasing fuel for its motor cars may be sure that the combined abilities of these Institute members are in a large part responsible for that reduction.

The operator, when he specifies A.P.I. standards for his oil-field equipment, realizes that the efficiency of the equipment, and the quality of the material used in it, are high, largely through the efforts of experts in these departments. He also realizes that he could not hope to purchase this experience himself.

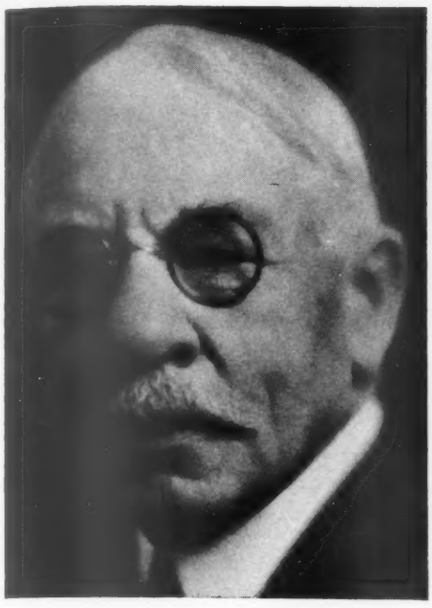
The workman may not only feel protected by the vigorous safety program which has been prosecuted by the Institute, but he may also feel secure that his materials and equipment will not break down, perhaps injuring or killing him.

The inventor, the technical man, the marketer, the accountant, the pipe liner, and any man in the oil industry down to the roughneck on a drilling rig, is in many ways affected by the work done by the Institute. And all the dividends accruing from the varied programs of the A.P.I. must eventually reach the consumer in two all-important forms—price and quality of product.

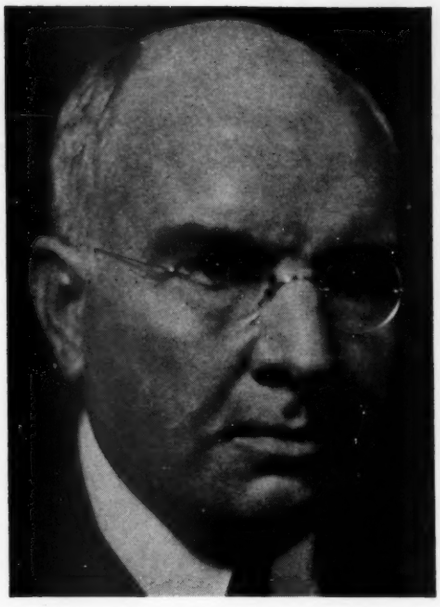
From the day when Colonel Drake's "folly" produced its first few gallons of petroleum in 1859, until the organization of the A.P.I., the history of the oil business was, in the words of John R. Rockefeller, a picture of "reckless waste and ruinous competition." During the first 60 years of its existence, the oil industry managed to effect a minimum of scientific advancement, remaining on the whole a romantic, impractical adventure.

During the 21 years following that period, the oil industry passed from this chaotic state of utter disorganization into as orderly a pattern of mechanical precision as could be expected of this thoroughly American business. It is only fitting to note that the industry has risen to its present place with the development of the Institute.

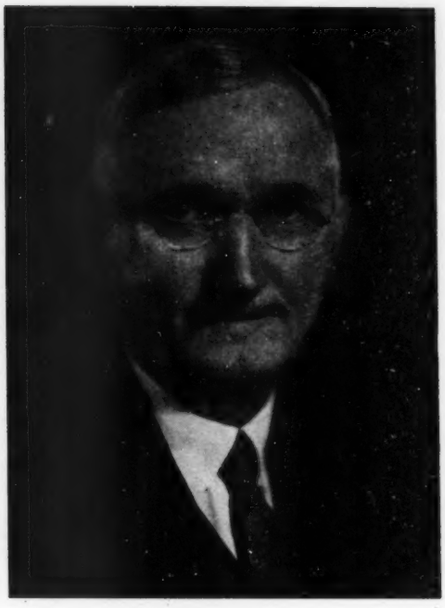
In view of these facts, it would be safe to assume, although stagnation might not result, certainly the absence of the American Petroleum Institute would again pit operator against operator in the progress-retarding rivalry of the early days of the petroleum industry.



E. W. CLARK (Deceased)
A.P.I. president 1927-28



AMOS L. BEATY (Deceased)
A.P.I. president 1932



C. B. AMES (Deceased)
A.P.I. president 1933

Research Program of Prime Importance

THE AMERICAN PETROLEUM INSTITUTE can well be proud of its record in fostering research and in disseminating the results of this research. At the annual meetings of the Institute, petroleum technologists from all parts of the world attend technical sessions which rank in importance with the proceedings of the greatest scientific societies. Periodically, throughout the country, are held chapter and group meetings which are attended by thousands of engineers, superintendents, drillers, and roustabouts. At each meeting one or more papers are presented on the problems of the industry, new methods and practices are discussed, with the result that the efficiency of operators is generally increased.

Nowadays these meetings are taken as a matter of course, but had it not been for the work of the A.P.I. in breaking down the old tradition of secrecy it is doubtful if they could have taken place. Before the war, cooperation between competing companies in the development of new practices was almost impossible. There was not a great deal of research carried on and what did exist was not of high quality because of the individualistic method in which it was conducted. Today, engineers and technologists working for competing companies get together and cooperatively solve their problems. Everywhere there are engineering committees at work on field problems with the result that the estimated recovery of oil from a sand has risen from around 25 per cent to 60 per cent.

Traditionally, oil has been the forgotten subject in American colleges and universities. Petroleum geology was not considered quite respectable and the chemistry of the hydrocarbons was treated as a simple preliminary to a course in organic chemistry, something that had to be discussed for the sake of completeness but which was of little real importance. Scientific societies generally neglected oil and those organizations which had grown up among oil men had little contact with the academic world. The A.P.I.'s program of fundamental research has done more to break down this barrier than any other effort.

Fundamental Research in Petroleum

In November 1925, John D. Rockefeller presented to the research committee of the Institute the sum of $250,000 payable at the rate of $50,000 a year for research in the geology, physics and chemistry of petroleum. The Universal Oil Products Co. gave a similar sum and within 2 years 39 projects were under way. Of these projects, 8 were geological, 16 were physical and 15 were chemical. Research associates worked with the U. S. Geological Survey and the U. S. Bureau of Standards in Washington as well as in the laboratories of a score of universities.

The Institute enlisted the support of the National Research Council which set up a central petroleum committee on which there were three chemists, three physicists, three geologists and three officers of the A.P.I. This committee considered proposals of projects and selected those to be supported by the Institute. As this program was one dealing with fundamental research on petroleum, no problems of immediate practical value were considered. The whole purpose was to increase knowledge of the nature of petroleum and of its environment in the reservoir. From it, however, there has come an ever-increasing number of practical applications which have made many millions of dollars for the oil industry. The value of so-called "useless research" was definitely established and today practically every company of any size has men working on fundamental problems, many of which originated from this program.

At the end of the 5-year period, work on many projects had been completed and two more had been added, making a total of 41 projects attacked. By July 1, 1930, 117 papers had been published or approved for publication, giving results of research done by A.P.I. research fellows. These papers appeared in such journals as the Journal of the American Chemical Society, Industrial and Engineering Chemistry, Bulletin of the American Association of Petroleum Geologists, the Bureau of Standards Journal of Research, Physical Review, and others whose standing definitely indicates the high quality of the work done.

During the next year, the number of papers published in scientific journals by A.P.I. research fellows or approved for publication had increased to 155 and although the program officially ceased, except for three projects which were continued, study of the various problems has gone on almost without a pause since that time.

Results of Fundamental Research Program

Space does not permit the listing of the topics studied or a detailed discussion of their value to the industry but it is unquestionably true that much of our knowledge of secondary-recovery methods, of the preparation of special products from oil, of the treatment of sulfur-bearing crudes, of polymerization, dehydrogenation, and of many other matters of prime economic importance stems directly from these projects or from research stimulated by the publications of A.P.I. research fellows.

The 41 projects employed as fellows or assistants some 200 researchers, many of whom are continuing their work in company laboratories or on university faculties where they train students for the industry.

Stimulated by the A.P.I. research program, fundamental research on petroleum geology, chemistry and physics is being carried on in many universities whose faculties scarcely knew a score of years ago that there were any problems in these subjects. Also stimulated by this research many oil companies have highly trained staffs who have contributed greatly to our knowledge of the fundamentals of petroleum.

Corrosion

Contemporaneously with the fundamental research program, the A.P.I. financed a study of corrosion of pipe lines and other oil-field and refinery equipment. Work was carried on in the field and

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Congratulations A. P. I.

November, 1940. Again, the American Petroleum Institute assembles for its annual convention.

Coincident with this meeting, Schlumberger pauses to observe that more than a *decade* has elapsed since it introduced electrical logging to the oil country.

In retrospect, it can point with pride to many achievements in the technique of well investigation, which it invented and in which it maintains undisputed leadership.

Again, Schlumberger gratefully acknowledges the cooperation of the petroleum industry.

SCHLUMBERGER WELL SURVEYING CORPORATION · HOUSTON, TEXAS

in the laboratory with the active cooperation of practically every company interested in the problem. Pipe coatings were subjected to tests under various conditions, the metallurgy of pipe was studied, experiments on combating corrosion were carried on until a great mass of information covering all phases of the problem was made available. The work of this committee is continuing under the direction of a group of pipe-line engineers representing practically all of the major companies.

This project illustrates the way in which the A.P.I. has benefited the small operator. Naturally, only major companies can maintain staffs large enough to permit the study of corrosion problems. These interested engineers meet, discuss their problems and assign projects. Work is carried on at the expense of the oil companies and is made available through publication or through the presentation of papers at meetings to all elements of the industry whether they have contributed to the solution of the problem or not. The prime object is the solving of a problem for the benefit of the industry as a whole, not for the benefit of a few large companies.

This method of attacking problems is carried on in almost every field. Oil-company engineers are detailed by the companies to serve on A.P.I. committees along with representatives of supply companies and service companies. The work of these committees is made public in the shortest possible time. Every meeting of the A.P.I. or of any division develops into a forum where papers are discussed in detail and this discussion is also made available to the industry. After the presentation of a paper, members relate experiences pertinent to the subject matter of the paper and show how they solved their problems. No paper is permitted a place on the program which is not of wide interest so that the papers and the discussions that follow are eagerly read by every progressive operator.

Crooked Holes—Unitization

A little over a decade ago, crooked holes were costing the oil industry many millions of dollars annually. As soon as this fact was realized, the Division of Production of the A.P.I. began to study the problem. Questionnaires were sent out to hundreds of engineers and the mass of information received was turned over to a committee which compiled from it a detailed discussion of the subject and made recommendations for the cure of the evil.

The result of this study was the complete disappearance of the problem, and the interesting development that since the cause of crooked holes was known, it was possible to turn the liability into an asset. By controlling drilling, it was possible to drill wells directed so accurately that they could tap others which had blown out and put them under control. Or from 2 to 20 wells could be drilled from a single location and so directed that they would be spaced at proper intervals on reaching the sand. In this way, the possibilities of drilling submerged locations were greatly increased.

It might be considered that this development would have come about anyway, had there been no A.P.I., but it is questionable if this view is tenable. Certainly the conversion of randomly crooked holes into directionally drilled holes would not have come so quickly without the Institute. Under the old tradition there were too many possible grounds for legal battles over the study of wells which might have wandered across property lines. Had it not been for the pioneer efforts of the A.P.I. in breaking down this distrust of the other fellow's motives which lay uppermost in the minds of most operators, the cooperative attack on the problem could not have taken place.

The principle of unitization was first advanced by Henry L. Doherty at a meeting of the A.P.I. This practice which is now generally recognized as the most efficient and economical way of operating an oil field can not be put into operation unless there is general agreement among operators as to the optimum spacing of wells and best method of producing them. Before this agreement has been reached there must be a full discussion of all phases of production. Here, the A.P.I. fills a very definite need. At general and chapter meetings production problems are discussed at length and these discussions pave the way for agreement as to the best practice for specific fields.

A study of optimum well spacing necessitates free discussion of production statistics and practices. Formerly production statistics were guarded jealously because to show that one company produced more or less oil than its neighbor invited trouble for all parties concerned. Again it was necessary for some organization to break down the barricades which prevented the free dissemination of this vital information, and again the A.P.I. by its policy of education filled the role.

By enlisting the support of company executives, it was able to secure the services of the technicians who worked under these executives. In this way it was possible to secure cooperation upon all problems dealing with production, drilling, refining and transportation of oil.

Throughout the years, the missionary work of the A.P.I. has transformed executives who were distrustful of one another and loath to give out any information which could conceivably be of any value into enthusiastic supporters of cooperative research programs dealing with the most practical problems affecting the industry.

Relationship With Other Societies

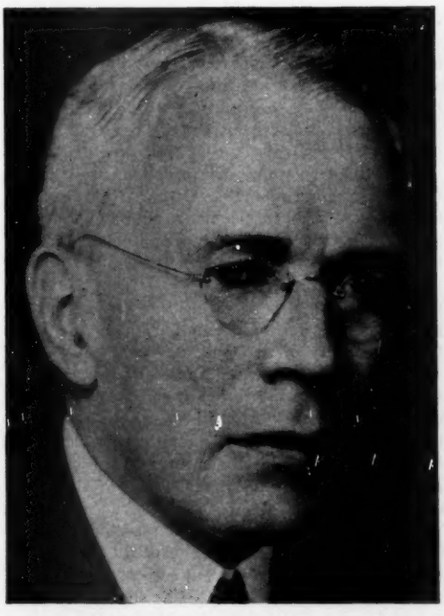
It has already been pointed out how the results of A.P.I. fundamental research were published in journals not connected with the Institute. This not only indicates the high quality of the work but it also illustrates the cooperation which exists between the A.P.I. and other technical groups. Many projects started under A.P.I. auspices are carried on in their later stages by the American Association of Petroleum Geologists, the American Institute of Mining and Metallurgical Engineers, the American Chemical Society and other organizations. The policy of the A.P.I. has always been to encourage the interest of other societies in problems relating to oil on the theory that cooperation is essential to the solution of these problems.

This policy has had a beneficial influence on members of the Institute. It is very difficult to encourage a member of one's staff to work cooperatively with other members of an A.P.I. committee and then refuse to permit him to work cooperatively with another organization such as the A.A.P.G. or the A.I.M.E. As a result, company geologists and engineers are presenting papers before these bodies in increasing numbers and the wealth of experience these men possess is making the transactions of these societies more valuable every day.

As local chapters of the A.P.I. become better organized, the value of the work done by its members increases greatly. The annual meeting is attended by some 3,000 oil men and the semiannual or summer meeting by another 700 to 1,500, but between last year's annual meeting and the May, 1940, meeting, there were 29 chapter meetings attended by 9,495 oil men. At these meetings 61 papers were presented. Thus, the educational work of the A.P.I. has expanded from an original attendance of 420 at its first annual meeting to a total attendance of 14,021 at meetings held over a 7-month period during the current year. If committee meetings are considered, it is estimated that in a 12-month period gatherings of oil men held under the sponsorship of the Institute have a total attendance of upwards of 75,000.

That the American petroleum industry stands well in the lead as compared with other countries, and from the standpoint of efficiency and technical skill stands in the forefront of American industry, is in great part due to the lessons in cooperation it has learned from its Institute. The high quality and skill of its labor is in great part due to the educational program of the A.P.I.

It may safely be said that there is not a phase of oil technology that has not been attacked by A.P.I. committees and the lion's share of the credit for the advances made in all of these fields goes to these committees. In spite of the amount of work done there still remains even more. For anything to interfere with the efficient technological and scientific program of the A.P.I. would be nothing short of a calamity. Upon it more than any other body depends the efficient development, conservation and exploitation of our petroleum resources.



EDWIN S. HALL
Secretary of the A.P.I.C.

OTTO DONNELL
Treasurer of the A.P.I.

Continuous Logging at Rotary Drilling Wells

By J. T. HAYWARD
Barnsdall Research Corp., Tulsa

A. P. I.

The author discusses the development of procedure and equipment now being used successfully in detecting relatively small quantities of oil, water, and gas brought to the surface from the bottom of a drilling well by mud-circulating fluid used in rotary drilling, together with the method used in determining the depths of the horizons where the samples entered the well bore.

He describes in detail a number of instruments that have been placed upon a panel and installed in a trailer; the trailer is moved from location to location as the drilling rig is moved. most of these instruments are concerned with the logging of the well as drilling progresses. With these new instruments and methods it now is possible to drill ahead continuously, and to know fairly accurately the type of formation that is being drilled through—its oil, water, and gas contents, and its depth. Information of this nature, obtainable while drilling, is quite helpful—not only in determining completion procedures, but also may become useful in the later life of the well in producing or reconditioning operations.

Paper was presented before Division of Production at the annual meeting of the American Petroleum Institute, Chicago, November 11-15, 1940.

MODERN rotary-drilling equipment can make hole remarkably rapidly, but with conventional procedures progress is retarded when it becomes necessary to determine the nature of the rocks drilled and of the fluids contained therein.

Until recently, the usual methods for making these determinations were: vertical coring, sidewall coring, drill-stem testing, and electrical logging—all of which called for interruption in the drilling operations.

Equipment has been developed to give a continuous log of the electrical resistance of the rocks drilled, while drilling; and, considering the technical difficulties involved, remarkable progress has been made. But the system is not commercially

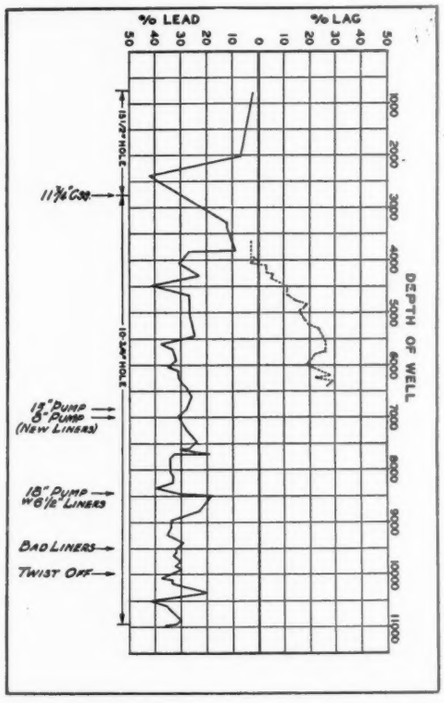


Fig. 1—Actual number of pump cycles required to bring sample to surface compared with calculated number at two typical wells

available yet, and for this reason—and because the methods and equipment have been described adequately in another place—it is not further discussed in this paper.[1]

Cuttings (ditch samples) long have been used for logging, and no interference with drilling is entailed; but difficulties in determining the depth to which the samples refer have limited the use of the method except for rough work.

Drilling rate also has been used, but instruments capable of giving a practical record have been developed only recently.[2 3]

Although the collection of cuttings and the observation of the drilling rate do not interfere with the normal drilling operation, they do not furnish a complete log, because they do not supply information regarding the fluid* contents of the rocks encountered; *and it is for the fluid contents, rather than for the rock itself, that wells are drilled.*

Under modern rotary-drilling conditions the hydrostatic pressure of the drilling fluid exceeds that of the fluids in the permeable rocks drilled through, so there can be no appreciable inflow from these rocks while drilling. Actually the flow is in the opposite direction, filtrate from the water phase of the mud penetrating into the permeable formations at a rate depending upon the wall-building ability of the mud.

Superficially it appeared, therefore, that the only ways to obtain an indication or sample of the fluid content of the rock would be to take a core and bring it to the surface, drill-stem test, or electrically survey and deduce the nature of the occluded fluids from the electrical resistance of the rocks containing them.

It occurred to the writer that possibly the comparatively very small quantities of fluid contained in the pores of the cylindrical core of the material actually drilled and pulverized by the bit were not flushed ahead of the bit, but carried to the surface by the circulating fluid; and, further, that although —owing to the extreme dilution—the presence of these fluids could not be observed by the unaided senses, suitable instrumentation would enable detection. Both these suppositions have proved to be well founded.

For logging purposes a further condition is necessary, viz., that after detection of the fluids at the surface, it must be possible to determine the depths from which they have been derived. Procedures and apparatus for doing this with reasonable accuracy have been developed.

A combination of the information to be obtained from the changes produced in the drilling mud during its passage through the drilling zone, to-

(Continued on Page 105)

WELL-LOGGING SERVICE

Location of Well — Company Well
Field, Goldsmith
County, Ector
State, Texas

Elevation

	From	To	Casing Record:	Observers:
Date logged	5/18/40	5/26/40	5½-in. outside-diameter at 4,105 ft	
Depth logged	3,800 ft	4,173 ft		

From (Feet)	To (Feet)	Remarks
3,800	4,085	7⅞-in. hole drilled.
4,085	4,105	7⅝-in. core head; 3½-in. core.
4,105	4,125	4¾-in. core head; 2⅛-in. core.
4,125	4,155	4¾-in. hole drilled.
4,155	4,173	4¾-in. core head; 2⅛-in. core.

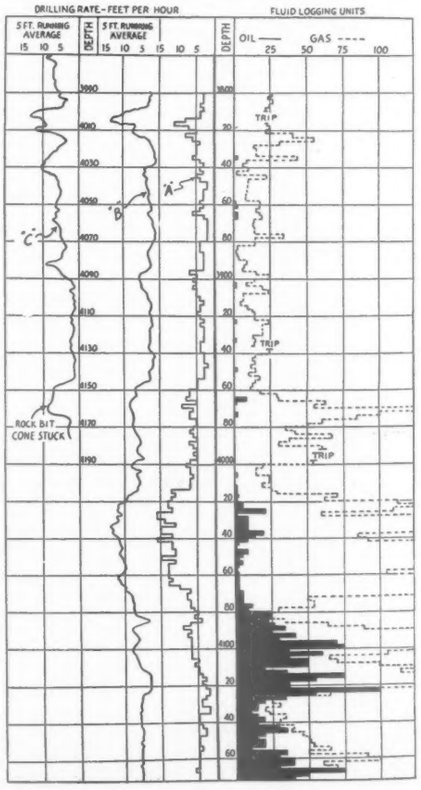


Fig. 2—Typical log

*"Fluid" is used in its wider sense, to cover gases as well as liquids.

gether with the information obtainable from the drill pipe by observing the drilling rate, the torque, the weight on the bit, and the vibration, make possible a fairly inclusive logging system that can be practiced with minimum interference with the drilling operations.

The following paper discusses the developments along these lines, with which the author has been associated.

Circulating Fluid as a Logging Means

From the early days of rotary drilling, cuttings carried to the surface by the circulating fluid have been used for logging purposes; but a great deal of development work requires to be done before anything but a very rough log can be obtained by this means.

Before the general adoption of the shale shaker, samples were "grabbed" from the ditch in various ways, and it was uncertain whether the cuttings consisted of material picked up by the circulating fluid during its last passage through the drilling zone, or of cavings of material that had been delayed on its way or had been carried around the system—possibly for days (but which originally had been obtained from formations many feet shallower than the depth of the well at the time of collection). These ditch samples usually are grabbed at regular time intervals, and theoretically represent varying vertical-drilled intervals whose lengths depend upon the drilling rate. It is realized generally that there is a "lag" between the departure of the cuttings from the bottom and their arrival at the surface, and it has been customary to try to allow for this lag by using a time interval calculated according to the depth and diameter of the well. The resulting log may be very much in error.

Fig. 3—External view of logging trailer

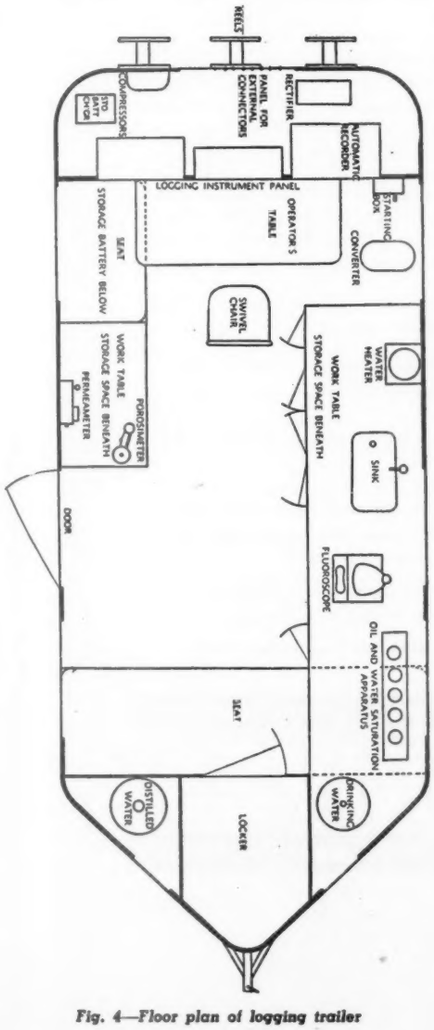


Fig. 4—Floor plan of logging trailer

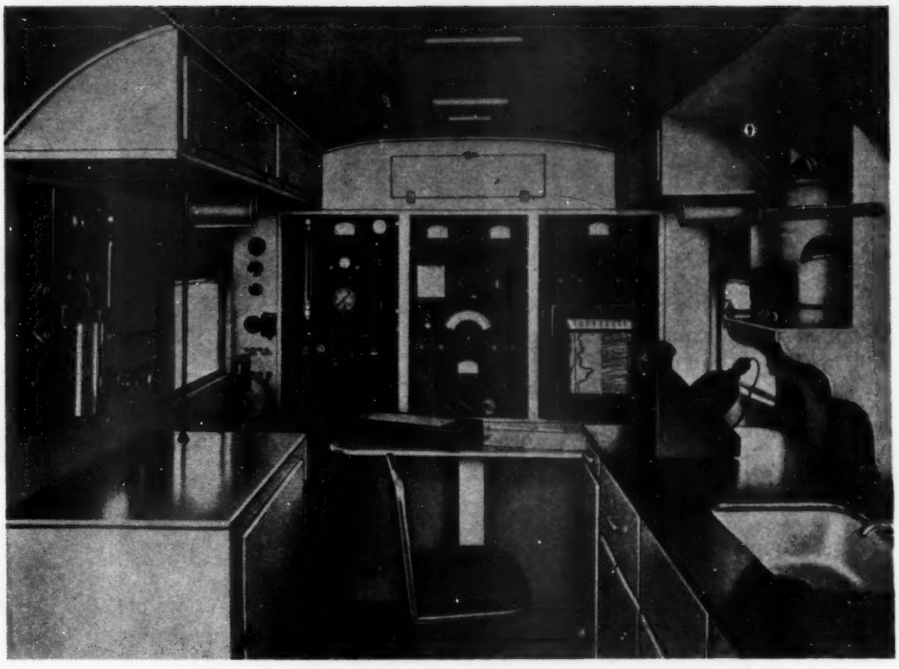


Fig. 5—Rear view, interior of trailer, showing instrument panel, oil detector, and phone to rig floor

The actual time taken for cuttings to reach the surface depends upon the rate of circulation, which varies frequently; upon the slip between the cuttings and the fluid (which varies over wide limits and depends upon the size, density, and shape of the cuttings); upon the viscosity of the mud; upon the number of collisions between the cuttings, the walls of the hole, and the drill pipe; and upon the condition of the hole.

Early tests carried out by the author indicated how unreliable could be logs based upon cuttings. In one test, which admittedly may represent extreme conditions, drilling was suspended in a 7,000-ft. well while circulation was maintained over a 6-hour period. During the latter part of the period, cuttings still were appearing on the shale shaker in large quantities, and it further was found that the nature of the cuttings could be varied by simply varying the speed of the pump.

Inasmuch as logging from the cuttings is at present not a feature of the logging system with which this paper is concerned, it is not discussed further herein.

In addition to the solid cuttings, the circulating fluid carries to the surface fluids originally contained in the pore spaces of the parts of the rocks drilled up by the bit. The material actually consists of a cylinder roughly equal to the bit diameter, and a length equal to the depth of the hole. Although it was known that the solids were carried to the surface, it appears to have been assumed either that the fluids were completely flushed ahead of the bit and driven back into the formation, or were present in the drilling mud in such small quantities that detection would be impossible. Early experiments by the writer demonstrated that both these assumptions were erroneous.

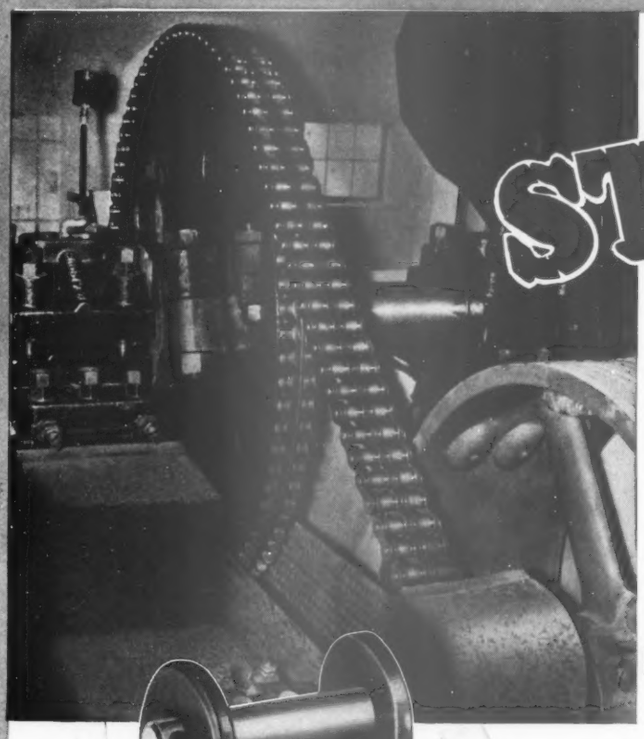
The following example indicates the theoretical concentration in the drilling mud of the fluids picked up by the mud during drilling, assuming that there is no flushing ahead of the bit.

Depth of well	6,000 ft.
Rate of circulation	800 bbl. per hour
Diameter of hole drilled	9 in.
Porosity	25 per cent
Rock pressure	200 atmospheres

The volume of each lineal foot of rock drilled will be 735 cu. in., and the pore space will be 184 cu. in. If the pores contain an incompressible fluid and the drilling rate is 1 ft. per hour, the fluid (if all added to the drilling mud) would be transported by the mud and delivered at the surface at the rate of 184 cu. in. per hour, and the concentration in the drilling mud would be 24 p.p.m. or approximately 0.0024 of 1 per cent. If, in place of an incompressible fluid, the rock contains a perfect gas, when measured under surface conditions (but neglecting temperature changes) the gas would be brought to the surface at the rate of 21.3 cu. ft. per hour—which, in relation to the drilling mud, represents 1 volume in 200 or ½ of 1 per cent.

The fluids encountered during drilling are oil, gas, and water. For the logging system under consideration, procedures and apparatus have been developed with which, under ideal conditions, oil can be detected in drilling mud when the concentration is only 10 p.p.m., and the presence of hydrocarbon gas can be detected when the rate of evolution is 2 or 3 cu. in. per hour; so that, under suitable conditions, it is possible to detect oil and gas picked up by the drilling mud from the pores of the rock drilled, even when the drilling rate is only 1 ft. per hour. The "ideal" conditions referred to seldom are met in the field; but fortunately fluid-bearing rocks usually are drilled at a greater speed than 1 ft. per hour, and the required sensitivity for detection is inversely proportional to the speed.

When the fluid in the rock is water, its detection depends upon the extent of its difference in some



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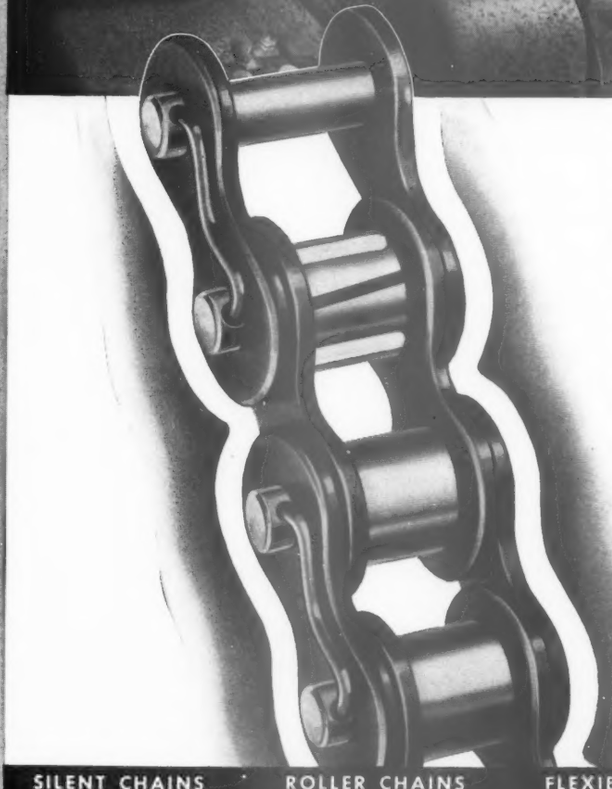
FOR OIL FIELD SERVICE



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respect to the water forming the fluid phase of the drilling mud. Because volumetric additions are obviously too small to be detected, detection must depend upon a change in the composition of the drilling fluid caused by the addition to it of the fluid contained in the pores of the core of rock drilled. Should this fluid be similar in all respects to the fluid phase of the drilling mud, its detection would be impossible. In many cases the salinity of the water in the rock is much greater than that of the drilling mud; and because, in addition, water-bearing sands are generally comparatively soft and drilled at a correspondingly high rate, the logging of these sands becomes possible.

Given the possibility of logging the top of oil, gas, and water sands through the medium of changes in the circulating fluid, a further condition is necessary in order to permit the logging of the bottom of the fluid-bearing sands and their thickness, which is that there must be no inflow of corresponding magnitude from the rock or rocks already penetrated. Because, under normal drilling conditions, the hydrostatic pressure of the mud column must be higher than the formation pressures, it appears unlikely that inflow can occur. Experience has shown that in most cases this is true: that inflow does not occur, and the bottom of the sands readily can be determined by a sharp drop in the oil, gas, or salt in the mud. Occasionally inflow is encountered; and, when encountered, it is generally from a gas sand.

Curiously enough these sands from which inflow occurs are generally noncommercial and of low permeability. The author believes that in certain areas there are small, relatively impermeable sands charged at abnormally high pressures. Gas from these sands may continue to "bleed" into the hole long after the bit has passed through them; but, as experience with their behavior has been gained, it has become possible to allow for them and to log other gas-bearing horizons encountered at lower depths. The ability of the gas detector employed to distinguish between dry and wet gas, i.e., between methane and mixtures of methane and higher hydrocarbons, is of great value in this type of logging. Although inflow from these high-pressure low-volume sands is too slow to cause blowouts, it may act as the trigger and allow a lower-pressure sand of greater capacity to blow out.

In addition to the detection of fluids, logging involves determination of depth of the rocks from which the fluids were derived. With the logging system under consideration, the depth determination is made by two independent means: First, the drilling-rate curve—which continuously and automatically is recorded against depth—indicates the top and bottom of the sands, in many areas, by the change in drilling rate. This information is insufficient, inasmuch as it does not define gas-oil or oil-water contacts, nor does it permit certain distinction between closely spaced thin sands containing different fluids. It is supplemented, therefore, by a second determination, which depends upon the volumetric metering of the circulating fluid.

Attempts to use a time interval based upon depth and diameter of the hole, and an assumed rate of circulation, proved to be extremely inconvenient owing to the bookkeeping involved, and also led to very serious errors. The method finally adopted involves the volumetric measurement of the circulating fluid. Several kinds of meters were developed and tried, but it was found that the positive-acting slush pumps provided the most convenient and reliable means of metering the drilling mud circulated. Fortunately, great accuracy is not required, because large quantities of drilling mud are circulated per foot drilled. At a well drilling at the rate of 20 ft. per hour and circulating 800 bbl. per hour, 40 bbl. of mud are circulated per foot drilled; and an error of 40 bbl., or 5 per cent, therefore, would involve an error of 1 ft. in the logged depth.

The use of the slush pumps for metering involves the counting of the cycles. It was found that, although the volumetric efficiency varies greatly from pump to pump and with the valve settings and general condition, it does not change rapidly except when an internal leak occurs. When a leak does occur, the part involved rapidly cuts out, so that the pump operates for only a short time at the abnormal rate, and only a very short section of the log, therefore, is involved.

It is also necessary to know the volume of fluid required to displace an increment from the bottom to the top of the hole. It soon was found that the actual values differed widely from the theoretical values, and that calculations could not be relied upon.

As finally worked out, the method adopted does not require the measurement of the actual volume of fluid handled by the pump or calculation of its volumetric efficiency, and does not require the calculation of the volume in the hole. Instead, the actual number of pump strokes or cycles required to get returns is determined experimentally from time to time. This is done by placing a "tell-tale" in the drill pipe when a joint is added, and observing the number of pump strokes performed before the tell-tale is returned to the surface.

Many dyes and different substances were tried out for this purpose. For instance, a few gallons of brine were put into the drill pipe, and their return in the drilling mud was picked up by resistance-measuring electrodes in the flow line. Such a tell-tale will travel several times around the system, the hump in the conductivity curve becoming flatter and wider on each trip. Inasmuch as salt water is one of the fluids to be detected, it is unsuitable as an indicator; and, after considerable experience and many trials, common oats were adopted as the indicator. When the drill pipe is broken to add a joint, a handful of oats is dropped into the joint at the top of the hole, and the number of pump strokes required before these oats appear on the shale shaker is observed. Deducting the number of strokes required to carry the oats to the bit gives the number of strokes required to bring them from the bit to the surface. Compared with the fluid indicator, it is found that oats or any other solids take a little longer and scatter a little more—probably due to the "slip" caused by collisions with drill pipe and walls of the hole.

In the Gulf Coast and similar areas, where comparatively viscous muds are used, the holes are generally "fast" (sometimes by as much as 50 per cent). That is to say that returns are obtained with only half the number of strokes indicated by calculations from the displacement of the pump and the volume in the hole. This is, in one respect, fortunate, as it reduces the time lag between the drilling of a short section and the availability of the information conveyed by mud at the surface. In other areas "slow" holes are found, and in West Texas, for instance, it is not uncommon for the observed value to be twice the calculated value.

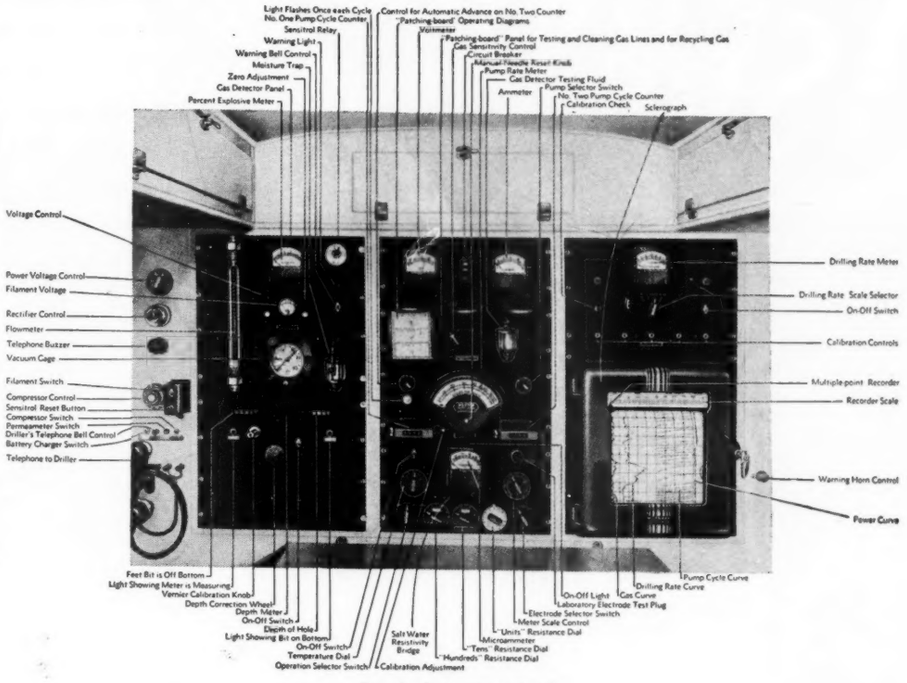

Fig. 6—Instrument panel

Fig. 1 shows two typical holes, one fast and one slow. It appears that very fast holes (i.e., 50 per cent or faster) presage stuck drill pipe, and that very slow holes accompany caved and washed-out holes and thinned mud. It is noteworthy that—even in a hole that is known to have caved—if viscous mud is used, the returns do not appear to be retarded.

Longitudinal mixing of the drilling mud is much less than might be expected, considering the agitation of the rotating drill pipe and the probable uneven nature of the walls of the hole. The extent of mixing is indicated by the dispersion or scattering of the tell-tale during its trip. In fast and normal-time holes the scattering is small. If a handful of oats is placed in the drill pipe, three-quarters of it will return and appear on the shale shaker in a distance of 100 to 200 pump strokes, followed by some widely dispersed strays which probably have been delayed by collisions with the drill pipe and walls of the hole. In very slow holes the tell-tale return may cover 1,000 or more strokes. Fortunately, slow holes usually are found in areas where the drilling rate is slow, so that 1,000 strokes may represent only 1 ft. or 2 ft. of section drilled. At the same time, mixing lowers the concentration of the fluids to be detected in the drilling mud; but here again conditions favor detection, as oil and gas are detected more easily in the thin muds which usually accompany slow holes.

The rate at which the fluid contents of the rocks

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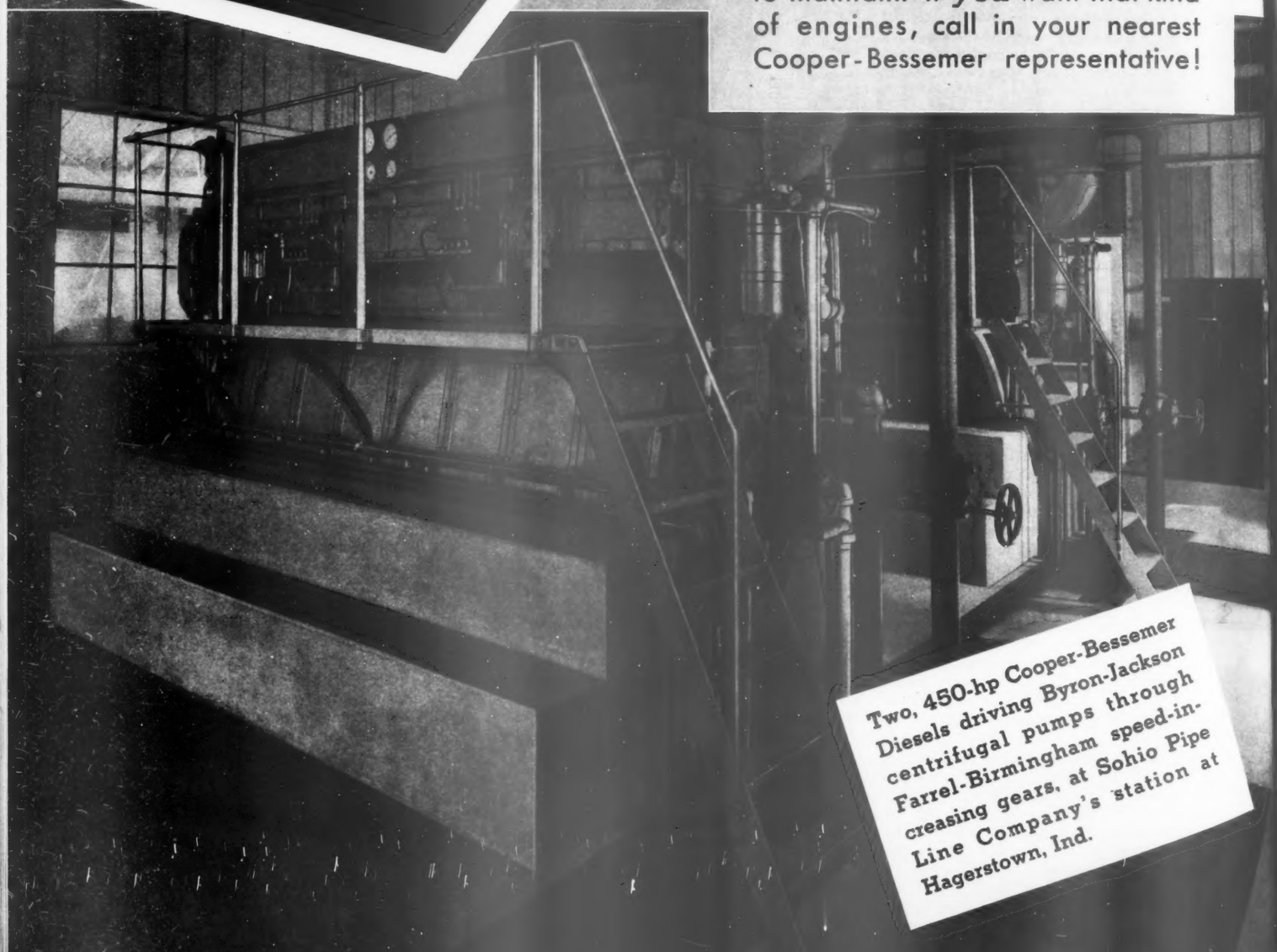

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drilled are picked up by the drilling mud can be expected to depend upon the drilling rate. In any rock with a given saturation, doubling the drilling speed, therefore, should double the rate at which the fluid is picked up and delivered at the surface—so that the observed values ought to have a correction factor applied to them, based directly upon the drilling rate. With the detecting methods used at present, this appears to lead to distorted findings for oil and gas, although it may be the correct method for salt water, and the use of the square root of the drilling rate appears to give more consistent results.

The drilling rate depends to some extent upon the permeability; and inasmuch as the possible productivity also depends upon the permeability, it appears likely that, if drilling conditions could be kept reasonably constant, the shows might best be logged as they appear and without applying any correction for the drilling rate.

There is, of course, a time interval between the drilling of a rock and the arrival of the information contained by the drilling mud at the surface. As a rough general figure this amounts to 6 minutes per 1,000 ft. The existence of this delay has been raised as an objection to logging by this means, but it must be remembered that the information obtained in this manner is available more quickly than it could be obtained by any other means at present commercially available. For instance, if it is not wished to drill into the sand more than, say, 10 ft., and as the returns from a 5,000-ft. hole are obtained in about half an hour, it follows that at the worst the drilling rate must be limited to 20 ft. per hour. Actually such a situation seldom occurs, as drilling is allowed to proceed without being slowed down until the proximity of an oil or gas sand is indicated by traces of gas detected by the gas indicator in the overlying rocks, or until the actual entrance into a sand has been indicated by the drilling-rate curve.

Logging With the Drill Pipe

Observation of the manner in which the rocks drill, the rate, the weight on the bit, the torque, etc., provides a means of logging their hardness or drillability. Such a log eminently is suited for correlation purposes. The information is immediately available, so that comparison can be made with similar logs from other wells while drilling is actually in progress. Logging by this method also enables the determination of the tops and bottoms of possible producing sands. Inasmuch as the comparative drillability of rocks is related closely to their permeability, the log can be used in a manner similar to that in which the self-potential or so-called "porosity curve" of an electrical survey is used, but with the important advantage over the electrical survey that the log is drawn while the well is drilling.

It is most surprising that until recently no instruments were available to log continuously the drilling rate. True, in certain areas, logs have been drawn manually by marking the kelly and noting the time required to drill successive intervals; but this is a laborious operation, requiring continuous attention, so that it has been employed only while drilling short sections of special interest—and seldom, if ever, from top to bottom of the hole.

It is probable that the dearth of development along this line was due to the commonly held belief that the condition of the bit so would affect the record that it would be practically useless. This fear has proved to be almost entirely unfounded. It is comparative, rather than absolute, rates that convey the information; and the difference in the hardness of successive rocks is so great that a soft rock will drill much faster with a worn bit than a hard rock will with a newly run one. Further, once a bit begins to get blunt, it rapidly deteriorates so that no great distance is drilled with it, and consequently only a small section of the log is affected. If, in addition, bit changes are noted on the log, their effect can be allowed for.

If, in regular drilling practice, the feed of the bit were automatically controlled, the design of an instrument to produce a drilling-rate log would be comparatively easy; but with manual feed the bit often is lowered in small steps, separated by longer or shorter intervals of time during which there is no movement of the feed mechanism at the surface, although the bit may be drilling off and progressing. This situation is complicated further by the human element—the rate of feed frequently varying as the driller's attention is distracted by various happenings around the rig. A graph of the "rate of feed" against "depth," therefore, often runs from extreme to extreme, is very difficult to interpret, and is almost useless for correlation purposes. This difficulty largely has been overcome by averaging, and our experience has shown that the running average is much more desirable than an average taken over consecutive intervals.

Fig. 2 shows a log of a well at which drilling rate was obtained by timing consecutive 5-ft. intervals

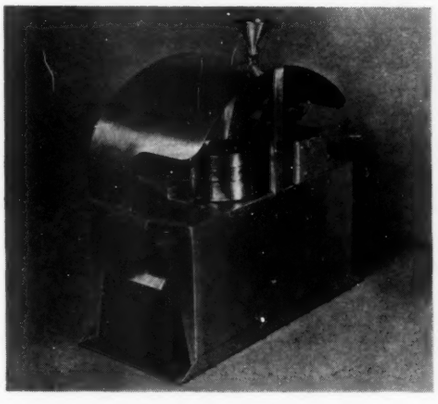

Fig. 7—Mud sampler

(curve *A*). Curve *B* was drawn automatically by the instrument on the same well, and curve *C* is the automatically drawn curve from another well in the vicinity.

The scale to be covered by a drilling-rate recorder is enormous, as the drilling rate may vary from one or two to several hundred feet per hour. This would appear to indicate a logarithmic scale, but our experience showed such a scale to be unsuitable, inasmuch as it interfered with easy correlation between logs obtained from wells drilled under slightly different conditions. Of the various scale arrangements tried up to the present, the provision of several scales has proved most satisfactory. The preferred ones are: 0 to 50; 0 to 100; and 0 to 500 ft. per hour—the scale actually selected depending upon conditions encountered at the well at the time. With each change of scale, it has been found desirable to change, at the same time, the interval over which the running-average speed is taken. With the 0-to-50-ft.-per-hour scale the speed logged is that at which the last 18 in. were drilled; with the 0-to-100-ft.-per-hour scale, the last 3 ft.; and with the 0-to-500-ft.-per-hour scale, either the last 3 ft. or 5 ft.—both having been tried.

Instrumentation

Sets of instruments for logging according to the method under discussion are installed in house-type trailers. Each trailer also includes equipment for core analysis and for the routine drilling-mud control; but as this equipment is routine and its description is not pertinent to the scope of the present paper, it is not discussed further.

Fig. 3 is an external view of one of these trailers. The reels at the back carry the cables that connect the trailer to the rig power supply, and the instruments in the trailer to their control points at the rig. Fig. 4 is a floor plan of the interior of a trailer. The instruments for logging, both by the drill pipe and the drilling mud, are grouped together on a panel across the back end of the trailer. Fig. 5 is a view looking towards this panel, and Fig. 6 is a closeup of it.

One of the chief difficulties met with in the instrumentation of a drilling rig is the absence, on most locations, of standard-frequency alternating current. The supply at many rigs is direct current (the voltage being far from regulated!). At others it may be high-line alternating current. The trailers have to be able to meet any condition in this respect and, therefore, contain a converter for converting direct current to alternating current, and a rectifier to supply direct current from alternating current. A 1½-kw. a.c. gasoline-driven generator also is available for jobs on which the rig supply is altogether unsatisfactory. The upper central panel, Fig. 6, is the power panel, and carries the necessary controls and instruments.

The first, and almost essential, requirement for any recording or indicating instrumentation at a well is means for continuously indicating depth, and for continuously driving a chart in synchronism with the depth of the hole. As previously explained, logged data are recorded preferably against depth in a manner similar to that in which geological logs and electrical logs are recorded, time-driven charts being entirely unsuitable.

This has been achieved for the logging system under discussion. The two counters on the left-hand lower panel continuously show the depth of the hole and the distance the bit is off bottom, while the chart in the recorder on the right is advanced longitudinally in synchronism with the depth. These operations are entirely automatic, and the instrument adds or subtracts joints of pipe as they are added or subtracted at the rig, and also distinguishes between reaming and actual drilling ahead. With the latest models the depth error is less than 6 in. per 100 ft. drilled. Means for correcting chart position every few hundred feet to bring it into agreement with drill-pipe measurements are incorporated, and the correction can be applied in a few seconds, without interrupting the operations.

The instrument on the right-hand panel, above the depth indicator, is the gas detector. A variable-speed motor-driven vacuum pump aspirates a measured quantity of air through a trap mounted on the flow line, and through a flexible hose to the trailer, where it passes through a filter, a humidifier, a flow meter, and a "hot-wire" bridge-type gas detector. There is no suitable volume meter available for covering the large range in volumes of gas that need to be dealt with in this application, nor for measuring the very small volumes met with; but the hot-wire type of instrument can detect very small volumes of combustible gas mixed with air. Readings can be obtained with as little as 0.01 cu. ft. of gas per hour, with the gas detector that is used in the trailer. Using this sensitivity, it has been found in a number of areas that traces of gas can be picked up in the cap rocks overlying gas and oil sands. By this means an indication of the proximity of a possible producing sand can be obtained 10 ft. or more before the bit actually reaches the sand.

Two filaments maintained at different temperatures are used in the instrument, enabling methane to be distinguished from gas containing the higher hydrocarbons, and a distinction is made

on the logs between dry and wet-gas shows.

A core holder incorporated with the gas detector enables cores to be examined for gas, 1 or 2 cu. in. of core material being ample for the purpose.

The gas detector is connected to the recorder, and its signal quantitatively is recorded on the recorder chart.

The lower instrument on the central panel is the salt-water detector. Electrodes placed in the flow line and in the pump suction measure the electrical resistance of the ingoing and outgoing drilling mud. Inasmuch as the electrical resistance of the drilling mud varies greatly with temperature, automatic temperature compensation is incorporated in the electrodes and in the bridge circuit. The electrodes are tubular in form, the measuring current being confined to the interior of the tube, so as to be unaffected by external conditions such as the proximity of the walls of the flow line or pump suction.

Because the mud is by no means homogeneous, and the resistance of the stream continuously varies due to the addition of makeup water, etc., it is necessary to compare the resistance of an increment of the stream as it enters the well with the same increment as it issues. This is done by superimposing the input-resistance log on the output-resistance log, with the proper phase displacement between them to allow for the lag. Lack of congruity in the superimposed curves on the log indicates changes caused by the passage of the mud through the drilling zone. For reasons previously stated, the detection of a salt-water sand requires that the fluid phase of the mud be comparatively fresh. In the trailer installations completed up to the present, the salt-water detector is not connected to the recorder.

The detection of oil is made by exposing a sample of the mud to ultraviolet light in the viewing box. This instrument can be seen on the sink at the right in Fig. 5. It consists of a light-viewing box containing a source of ultraviolet light and an alternate source of visible light. A magnifier is incorporated in the eye piece, and greatly assists the observations. A sample of mud is diluted with water, a viscosity and emulsion breaker added, and the sample placed in a 3-in.-diameter dish, which is inserted in the viewing box.

Under ultraviolet light oil fluoresces; but when present in the mud it does not show up as a fluorescent film, as might be expected, but as a number of bright specks on a dark background. the appearance resembling a starry sky. Origi nally it was anticipated that a show once picked up would go around through the pits, pump, and hole, and reappear; but little trouble has been experienced owing to this cause, the fluorescence due to the crude oil usually disappearing after the first trip. Occasionally it may reappear, but on a second trip the fluorescence is much dimmer and easily is distinguished by an experienced operator. Lubricating oil, which also fluoresces and which may drip into the mud from the rotary or run down from the swivel, gives rise to the chief operating difficulty. It often can be distinguished by the slightly different color (from most crude oils) with which it fluoresces; and, in any case, with a little trouble it can be kept out of the mud stream. Recently special nonfluorescent lube oils have been developed and made available for use when contamination is troublesome.

If the mud samples for the mud observations merely are grabbed from the mud stream, erratic results are obtained—probably because the rate at which the bit is fed down during normal drilling is far from constant. To overcome this difficulty a continuous sampler (Fig. 7) is employed in the ditch. The wheel of the sampler is turned by the flowing mud, and at each revolution a small sample is picked up and deposited in the container.

The instrument above the salt-water detector on the center panel (Fig. 6) is the drilling-mud meter and pump-cycle-rate indicator. Switches mounted on the slush pump transmit electrical impulses to this instrument. The rate at which the pump is running is indicated continuously on the large dial in the center of the panel, while the two counters, on the right and left, number the cycles. These two counters run in step, but one of them continuously leads the other by the number of cycles required to bring an increment of the circulating fluid from the bit to the top of the hole, this lead being determined experimentally, as previously described.

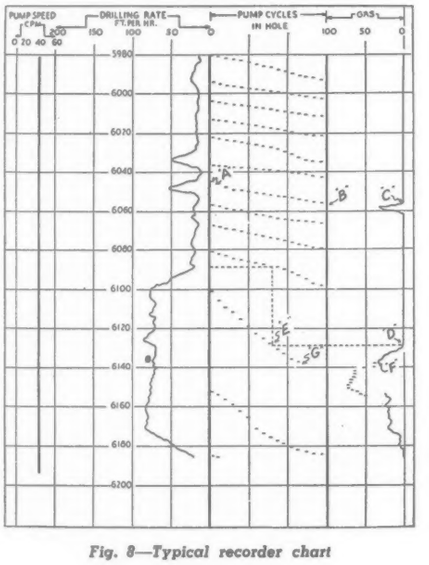

Fig. 8—Typical recorder chart

For example, suppose that the depth of the well is 6,000 ft. The operator notes the reading on the leading counter, which is, say, "500," and enters it alongside 6,000 ft. He repeats this operation again when the depth is, say, 6,002 ft., and finds, say, "1,000" on the counter. Inasmuch as the one counter leads the other by the number of cycles required to bring the sample to the surface, the operator knows that the sample relative to the drilling between 6,000 and 6,002 ft. will be arriving at the surface while the lagging counter reads from 500 to 1,000. Logging in this manner, of course, requires considerable attention on the part of the operator; but it is now no longer necessary because the recorder performs the operation entirely automatically.

The rate at which the pump runs is indicated continuously on the large dial of the instrument, in cycles per minute, and this indication has proved to have an important use unconnected with logging—which use is that on steam-driven rigs it gives an almost infallible warning of drill-pipe washouts before they have become serious enough to cause parting of the string. When a washout starts, the pump rate commences to increase, and continues to increase over a period of several hours until pipe failure occurs.

This speeding up is almost imperceptible to the driller, as it occurs so slowly; but it easily is noticed on the meter which, in addition to its indicating pointer, is provided with a hand that is manually set to the normal pump speed a few minutes after the pump has been started and has settled down. Speed changes due to variations in boiler pressure easily are distinuished from those due to an incipient washout, being up and down and of small amplitude, whereas the change due to a washout is a steady increase.

The instrument at the top of the right-hand panel is the drilling-rate meter, or sclerograph. It is designed to compute a continuous running average of the drilling speed over a predetermined drilling distance. This method of averaging has been found to be desirable (for reasons discussed in a previous paragraph). Four rate scales are available, the operator selecting the scale most suitable to cover the drilling-rate range at a particular well by means of the control switch in the center of the panel. The dial continuously indicates the drilling rate, and the instrument is connected to the recorder, so that a continuous record of the rate is made.

The recorder is situated on the lower part of the right-hand panel. It is of the multiple-trace type. The chart is driven longitudinally by the depth recorder, either 1 in. to 20 ft., or 1 in. to 50 ft. The drive is fully automatic, the chart does not back up when the bit is lifted off bottom to ream, and the addition or subtraction of joints of drill pipe is taken care of by the drive without any attention.

Fig. 8 is a short section of chart made by one of these recorders. Four parameters are recorded according to the present setup. Reading from left to right, the first trace is the slush-pump rate, in cycles per minute; the second is drilling rate; the series of lines in the third column is drawn by the pump-stroke counter; and the fourth trace shows the gas. The lines in the third column serve to relate a gas show to the depth from which it came. A dial on the pump-stroke counter is set to the number of pump cycles experimentally determined as required to bring a sample from the bit to the surface. The pump-stroke counter then causes the pen to move completely across the third column on the chart while this number of cycles is being performed, and continuously to repeat this operation.

Referring to Fig. 8, an increment of the circulating fluid which passed the bit (at *A* on the chart), when the depth of the well was 6,043 ft., arrived at the surface (*B* on the chart) when the depth of the well was 6,050 ft. The gas show which appeared at *C* (opposite *B*), therefore, came from 6,043 ft. There was another gas show which commenced at *D* when the depth of the well was 6,128 ft., and the dashed line on the chart demonstrates the manner in which the depth at which this gas was encountered in the well is determined, viz., 6,089 ft.

When the indication of the gas indicator exceeds a predetermined value (in the present case 35 per cent), the symbols used for the gas curve and the "cycles in the hole curve" automatically are interchanged, as at *F* and *G*. This assists the interpretation of the log at such times as when drilling has been suspended while circulation is continued.

Conclusion

The trailers and service now have been commercially available a little more than a year, and have been used on approximately 200 wells. In addition to logging, at present the trailers are equipped for routine drilling-mud control and for core analysis. The development is in the early stages, and it is expected that other functions connected with the logging and operation of drilling wells will be added as time goes on.

Bibliography

1. D. J. Hawthorne and J. C. Owen, "Mechanical Practicability of Electrical Logging While Drilling," Petroleum Engr. 11 [4] 71 (1940).
2. C. A. Yeatman, "Practical Utilization of Rate-of-Penetration Drilling Data," Proc. A.P.I. 21M [IV] 50 (Production Bull. No. 225) (1940).
3. "Automatic Geolograph Correlates Drilling Speed With Other Pertinent Data," Oil Weekly 93 [5] 11 (1939).

Emulsion Deoiling Process

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A. P. I.

This paper presents a new process for deoiling crystalline waxes, and summarizes the pilot-plant and commercial operations. The process utilizes water emulsions to effect continuous wax-oil separations. No expensive solvents nor solvent-recovery equipment is required. The processing time is a matter of minutes, rather than of days; and, therefore, automatic control is immediately effective. The plant cost and operating cost are low, and only exhaust steam is required for heating. The method may be applied to the complete processing of slack wax to semirefined grades, or may be used as an adjunct to existing sweating equipment.

The emulsion wax-separation processes are covered by the following U. S. Patents issued to Schutte: No. 2168140, 2168141, 2168142, 2168143, and 2168306; and pending applications for patent. The Lummus Co. is the sole licensor.

Paper presented before Refining Division at the annual meeting of the American Petroleum Institute, Chicago, November 11-15, 1940.

UNLIKE most refining processes, the separation of oil from crystalline waxes by conventional sweating has not been changed radically in the past years, and has been practically without competition in its field. The work of many investigators has increased the efficiency of sweating by extending the knowledge of the factors involved, and by improving the control methods. The equipment has been improved by mechanical refinements, but the method of separation has remained the same. Sweating is still a batch fractional melting, carried out on long time cycles, thermally inefficient and relatively difficult to control.

A new process now has been developed, based on a novel mechanism of wax-oil separation. Although the application of this principle permits the separation of any clean oil-wax mixture, the commercial development of the process thus far has been confined to the deoiling of sweater stocks. This has progressed from a pilot-plant operation on a wide variety of stocks, to commercial installations of 400 and 700 bbl. daily charging capacity. It offers the advantages of continuous operation under automatic control, low operating cost, and low plant cost. It is the purpose of this paper to present this process, describe its theory, the equipment employed, and the results obtained.

Theory of the Process

If an oily crystalline wax stock is cooled to a temperature below its melting point, the wax solidifies in well-defined crystals; but the system is not freely separable because the wax crystals impede the flow of the oil, and because the oil adheres to the crystals. An attempt to filter the material results in very imperfect separations and difficulty with plugging of the filter medium. If, however, the oily wax is emulsified in a nonviscous nonsolvent liquid, such as water, and cooled to precipitate the desired wax, with the process so controlled that the water is the continuous phase of the emulsion, then the droplets of oil and the wax crystals are separated by water, and a freely filtering substance is obtained. In practice the cooling and emulsification usually are carried out in the same zone by the addition of the nonsolvent liquid at a suitable temperature. The resulting material, which has the appearance of whipped cream, may be subjected to any kind of a liquid-solid separation, such as filtration or settling. The cake deposited on filtration, when the water and oil have been removed, is finely crystalline, porous, and may be washed readily with large volumes of water. A further fractional separation may be obtained by varying the temperature of subsequent water washes. It has been found that one of the most efficient methods of separating these emulsions is to charge them to a filtering-type basket centrifugal, suitably jacketed for temperature control and equipped with washing nozzles. When washes are used at temperatures considerably higher than the temperature of the charge emulsion, a partial shrinkage of the cake results in a squeezing action which aids the removal of the last traces of oil. When treated in this way the cake still retains its porosity, however, and allows a free passage of the wash liquid.

It will be noted that the process has the unique features of employing nonsolvent liquids, rather than solvent liquids, and of utilizing emulsions which up to now have been considered as undesirable nuisances by the petroleum refiner. In

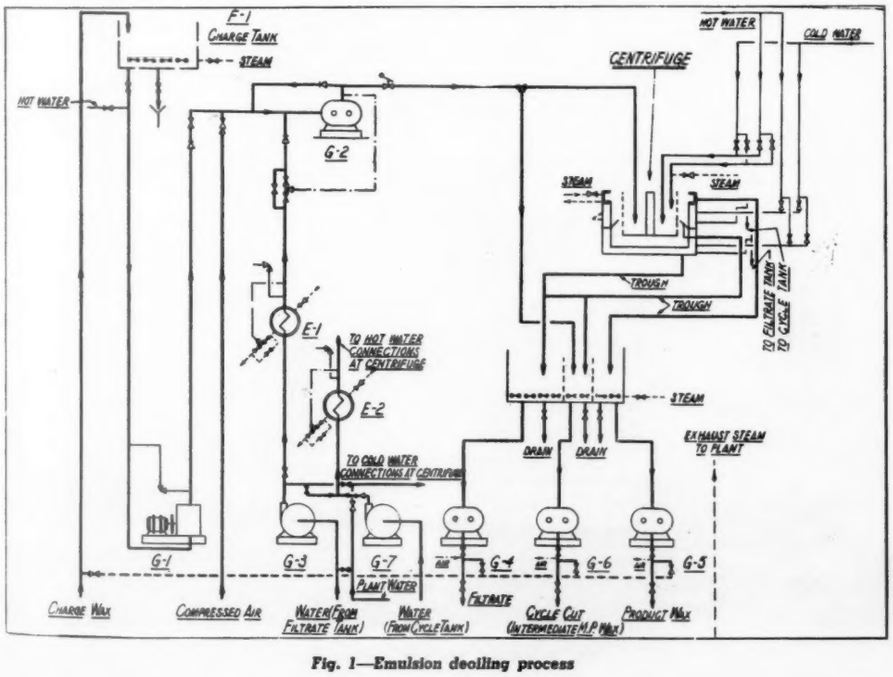

Fig. 1—Emulsion deoiling process

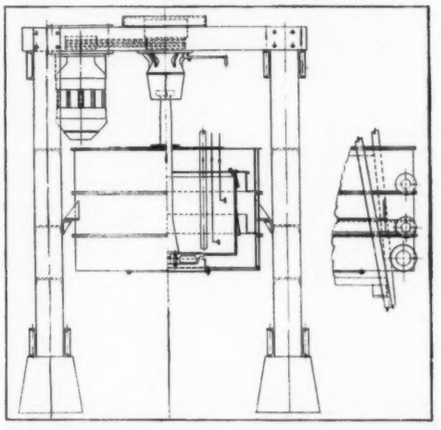

Fig. 2—Continuous emulsion deoiling centrifugal

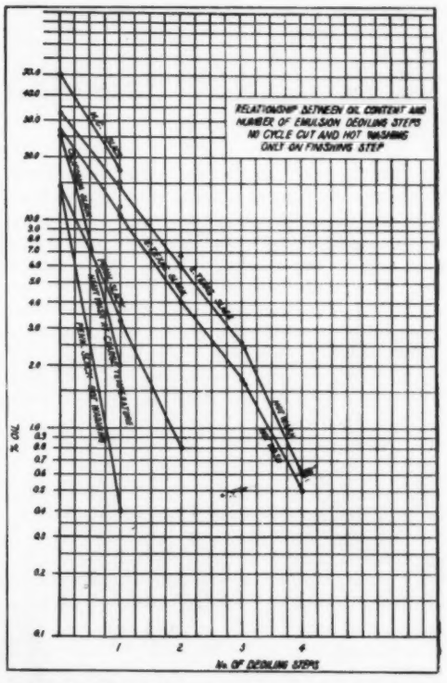
RELATIONSHIP BETWEEN OIL CONTENT AND NUMBER OF EMULSION DEOILING STEPS NO CYCLE CUT AND HOT WASHING ONLY ON FINISHING STEP
% OIL
No. OF DEOILING STEPS

Fig. 3—Relationship between oil content and number of emulsion deoiling steps; no cycle cut and hot washing only on finishing step

addition to the aforementioned benefits of emulsification, there is apparently an improvement in crystal structure, due to the fact that the wax is solidified from a thin interfacial film, rather than from the main body of a liquid. This effect has been noted in the commercial deoiling of waxes containing high end-point constituents which would render them virtually unsweatable. In this case the film crystallization apparently decreases the effect of the naturally occurring inhibitors.

Description of Processing Equipment

The equipment for a single-stage emulsion deoiling is shown on the flow sheet, Fig. 1. The oily wax to be processed is introduced by pump *G*-1 into the suction of the emulsifier *G*-2. The volumetric capacity of the emulsifier is 10 to 20 times the quantity of wax charged, and this excess material is bypassed back to the emulsifier suction. A small amount of compressed air is introduced with the wax. The temperature of the net emulsion is controlled by an automatic instrument operating on the water introduced to the emulsifier. The proportions of water and wax are adjusted by controlling the temperature of the water in exchanger *E*-1. The net emulsion is charged to a perforate-wall centrifugal lined with a filter medium. The unsolidified portion of the original waxy charge and the emulsified water are thrown out and collected in the lower portion of the jacketed housing surrounding the rotor. The deposited cake travels continuously up the wall of the machine as an annular mass, and is discharged over the top lip of the basket into a steam-jacketed melting ring, from which it flows to one compartment of tank *F*-2. The cake may be washed during its progress up the wall of the machine at several levels by water at controlled temperatures. The upper wash material may be withdrawn separately, and used as a recycle stock if desired.

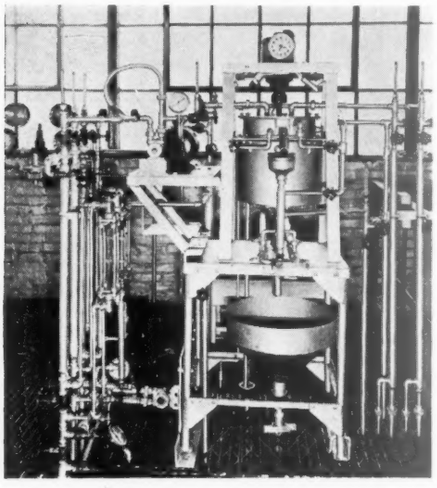

Fig. 4—Pilot deoiling unit

The operation of this type of centrifugal may be visualized more clearly by reference to the cross-sectional cut given in Fig. 2. The machine differs from a conventional basket-type filtering centrifugal in that the curb housing is divided into three jacketed sections. The top section is steam-heated for cake melting, and the other two sections allow control of the temperatures in the primary-filtration and washing zones. There is no mechanical means required to propel the cake upward and cause its continuous discharge, because the characteristics of the emulsion cause a self-propulsion of the cake. Due to the presence of emulsified water in the charge, the density of the material at the feed point is considerably greater than the density of the deposited cake. The internal pressure, acting on any particle of dry cake, is considerably less than that acting on a particle of feed slurry. This results in a net upward force in the cake, which displaces the cake as an annular mass upwards along the wall of the rotor. Studies of this action have been made by introducing feed slurries containing insoluble dyes. Cakes formed in this way then were cut into strips and removed. The line of demarcation between the undyed original cake and that deposited from the dye-containing subsequent charge is roughly a half-parabola having its axis along the surface of the filter medium.

A view of the pilot deoiling unit is shown in Fig. 4. This uses a 10-in. centrifugal which was remodeled from a standard small laboratory machine. The charging capacity of the unit is 10 gal. per hour.

The first commercial plant was built in an automobile box car, and so designed that the car can be placed on a refinery siding, requiring only the connecting of electrical power and exhaust-steam, water, charge, and product lines. This plant was designed for 400 bbl. per day of slack wax, and has exceeded this capacity in service. A general view is given in Fig. 5. Fig. 6 shows the charge pump, emulsifier, and water-heating exchangers. Fig. 7 is a view taken inside of the car, looking toward the 48-in. centrifugal; and Fig. 8 is a closeup of the centrifugal, showing the emulsion charge line, the wash lines, and the troughs which carry off the filtrate, and overhead cake. This plant has been operating in the Pennsylvania field since early in the spring, producing marketable wax from slack wax obtained by solvent dewaxing. The refinery has no sweating equipment, and this box-car plant, plus clay-percolation equipment, constitutes the entire wax plant.

A view of a 60-in. suspended centrifugal in a permanent 700-bbl-per-day installation is shown in Fig. 9, which is a photograph of the wash and jacket-water control manifold and part of the instrument board. This unit operates on a Mid-Continent slack wax from plate and frame presses.

TABLE 1—TYPICAL DATA, PILOT EMULSION DEOILING UNIT

	Charge stock source—	Charge: Melting point (°F.)	Charge: Oil* (per cent)	Product wax: Melting point (°F.)	Product wax: Oil* (per cent)	Yield, volume per cent on charge	Number of deoiling steps
1.	East Texas pressed slack wax	107	26	122.5	1.7	40.2	3
2.	East Texas pressed slack wax	107	26	129.5	0.5	25.8	5
3.	East Texas pressed slack wax	112.5	30	122.5	10.7	57.5	1
4.	Mid-Continent cold pressed slack	96	(too high)	115.5	11.8	13.3	1
5.	Mid-Continent cold pressed slack	96	(too high)	105	34	36.0	1
6.	Pennsylvania solvent-dewaxing slack	122.5	(10.0)	127	(0.7)	62.0	1
7.	Pennsylvania solvent-dewaxing slack	122.5	(10.0)	130	(0.2)	41.5	1
8.	Pennsylvania slack wax	115	(20)	122.5	(5.5)	72	1
9.	Mid-Continent pressed slack wax	108	35.6	115	16	71	1
10.	Mid-Continent pressed slack wax	108	35.6	119.5	5.5	43.8	1
11.	Mid-Continent pressed slack wax	108	51.4	118	26.6	51.4	1
12.	Far-eastern wax stock No. 1	99	32.6	107	13.6	34	1
13.	Far-eastern wax stock No. 1	99	32.6	109	7.3	24.8	2
14.	Far-eastern wax stock No. 2	116	11.8	118.5	7.1	86.5	1
15.	Far-eastern wax stock No. 3	135.1	3.9	138.5	1.2	72.2	1
16.	Mid-Continent pressed slack wax	108.5	36	117.6	16.5	64.1	1
17.	East Texas pressed slack wax	105.6	42.2	115.8	20.3	60.2	1
18.	California solvent-dewaxing slack	121.6	25.1	128.7	2.0	59.0	1

*Oil contents run by modified A.S.T.M. procedure using special light cloth, correlated with solvent method. Oil contents enclosed in parentheses run by A.S.T.M. method D-306-29-T.

TABLE 2—PILOT-PLANT DATA, SINGLE-STAGE EMULSION DEOILING FOLLOWED BY SWEATING

Emulsion deoiling operation—once through:	East Texas pressed slack wax
Charge:	
Melting point, °F.	112.5
Oil, per cent	29.8
Cake:	
Yield, volume per cent on slack	57.5
Melting point, °F.	122.5
Oil, per cent	10.7
Filtrate:	
Yield, volume per cent on slack	42.5
Melting point, °F.	93

Single sweating operation:	Cut No. 1	Cut No. 2	Cut No. 3	Semirefined
Volume per cent on deoiled cake	20.6	2.1	38.3	39.0
Volume per cent on original slack	11.9	1.2	22.0	22.4
Melting point, °F.	95	115.5	123.8	132.0
Oil, per cent	...	15.6	0.8	0.14
Tensile strength, lb. per sq. in.	...	....	....	412

Pilot-Plant Operations

Typical data for pilot-plant emulsion deoiling operations on various stocks are presented in Table 1. These stocks include three East Texas pressed slack waxes, Mid-Continent cold-pressed

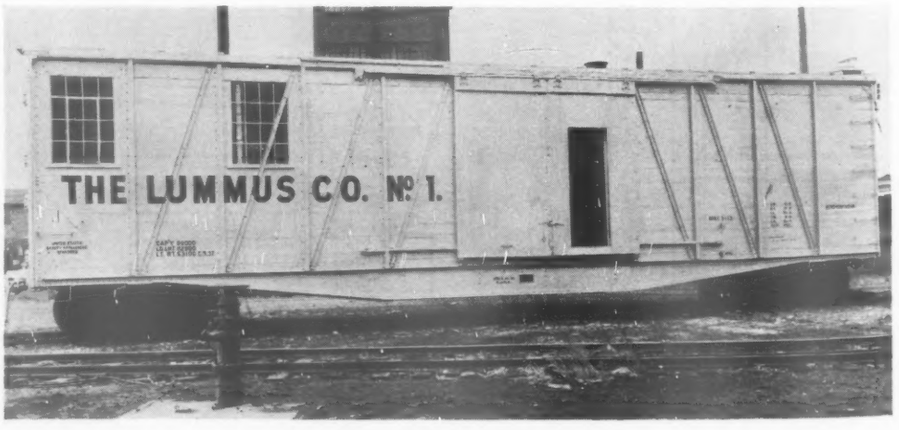

Fig. 5—400-bbl. per day deoiling unit.

slack, Pennsylvania and California solvent-dewaxing slacks, and far-eastern wax stocks. In most of these runs hot washing was used only on the final finishing step, inasmuch as the pilot unit has no side cut to segregate the hot-wash filtrate from the primary filtrate or foots oil. The degree of oil separation obtained on the California solvent-dewaxing slack in a single-step process is much greater than that shown for the other stocks. This is a reflection of the improvements made in the pilot-plant equipment in the last few months. Fig. 3 is a plot which shows the relationship between the oil content of the charge wax and the oil content of the cake obtained from each deoiling step, when hot washing is used on only the final operation. It will be noted that there is a definite and constant relationship between the oil contents remaining after each pass. With the exception of the California slack wax, this relationship indicates the equilibrium obtained in the original emulsion charged to the centrifugal. In the case of the California stock, several improvements have been made in the emulsification system, and a heavy well-distributed wash was employed at the charge temperature. The factors influencing the degree of oil separation are as follows:

1. The crude source from which the slack wax is obtained. This effect will be noted by the difference in the slopes of the lines for well-fractionated sweatable slack wax from various crude sources.

2. The percentage of oil in the original charge.

3. The degree of fractionation obtained in the distillation unit which produced the original wax distillate. As pointed out previously, this effect is less important in emulsion deoiling than in conventional sweating. Poorly fractionated slack wax usually gives no trouble with operation in emulsion deoiling, but the structure of the final product wax is apt to be poor. The curves of Fig. 3 are given to show the relationship between the oil content of the charge and that of the solid phase in the original emulsion, and they do not represent the ultimate separation possible by washing and by the segregation of the hot-wash filtrate.

Table 2 gives the result obtained by a single-stage emulsion deoiling of an East Texas pressed slack wax, followed by a single laboratory sweating. The original slack charged to the emulsion deoiling operation had a melting point of 112.5° F., and contained 29.8 per cent oil. A yield of 57.5 per cent of cake was obtained with 122.5° F. melting point, and an oil content of 10.7 per cent. This cake sweated to 22.4 per cent on the original slack of 132° F. melting-point semirefined wax, having an oil content of 0.14 per cent and a tensile strength of more than 400 lb. per sq. in. The next cut of 22.0 per cent on the slack was of 123.8° F. melting point 0.8 per cent oil. This shows that stocks which have been partly deoiled by the emulsion process give good separations upon subsequent sweating, and yield products of high quality.

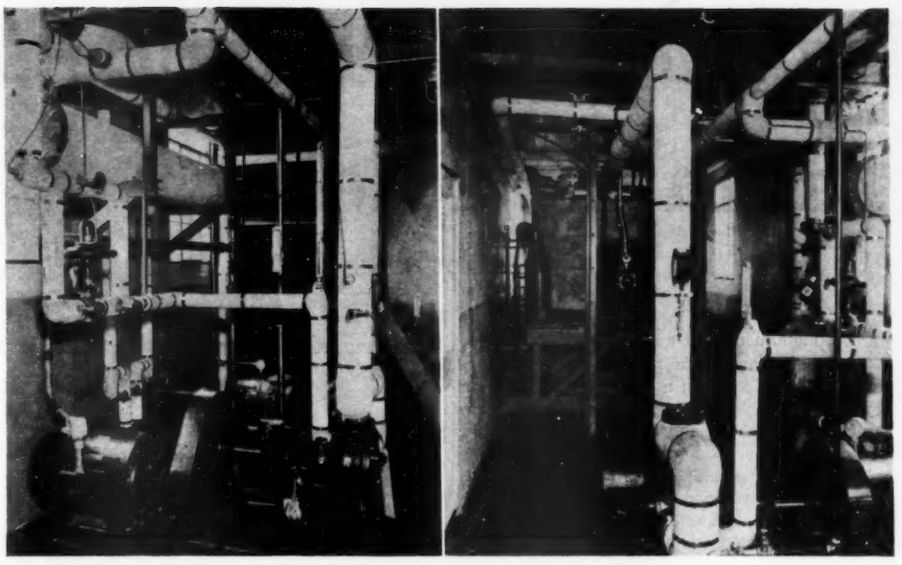

Fig. 6—(Left) 400-bbl. per day deoiling unit; showing charge pump, emulsifier, and water-heating exchangers. Fig. 7—(Right) View of inside of box car looking toward centrifuge.

Commercial Operations

The results obtained from the commercial operation of an emulsion deoiling plant having a 48-in. centrifugal are given in Table 3. The charge stocks were obtained from solvent dewaxing of Pennsylvania distillates, and the plant usually was operated for a crude-scale product. It will be noted that the overall yield was 60.6 per cent of 130° F. melting-point scale wax, containing 0.4 per cent oil. The operation shown in Column C is of interest because of the high degree of separation obtained on a charge material containing high end-point waxes which normally would be unsweatable. The oil separation from 21 to 1.3 per cent, upon rerunning the filtrate, is also of interest. The operation in Column F shows the production of a semirefined wax in a single step from solvent-dewaxing slack.

Reference to the utility data shows an economy of operation in marked contrast to conventional sweating, as evidenced by the overall utility cost of only 1.8 to 1.9 cents per barrel of charge.

The operating performance for a deoiling unit

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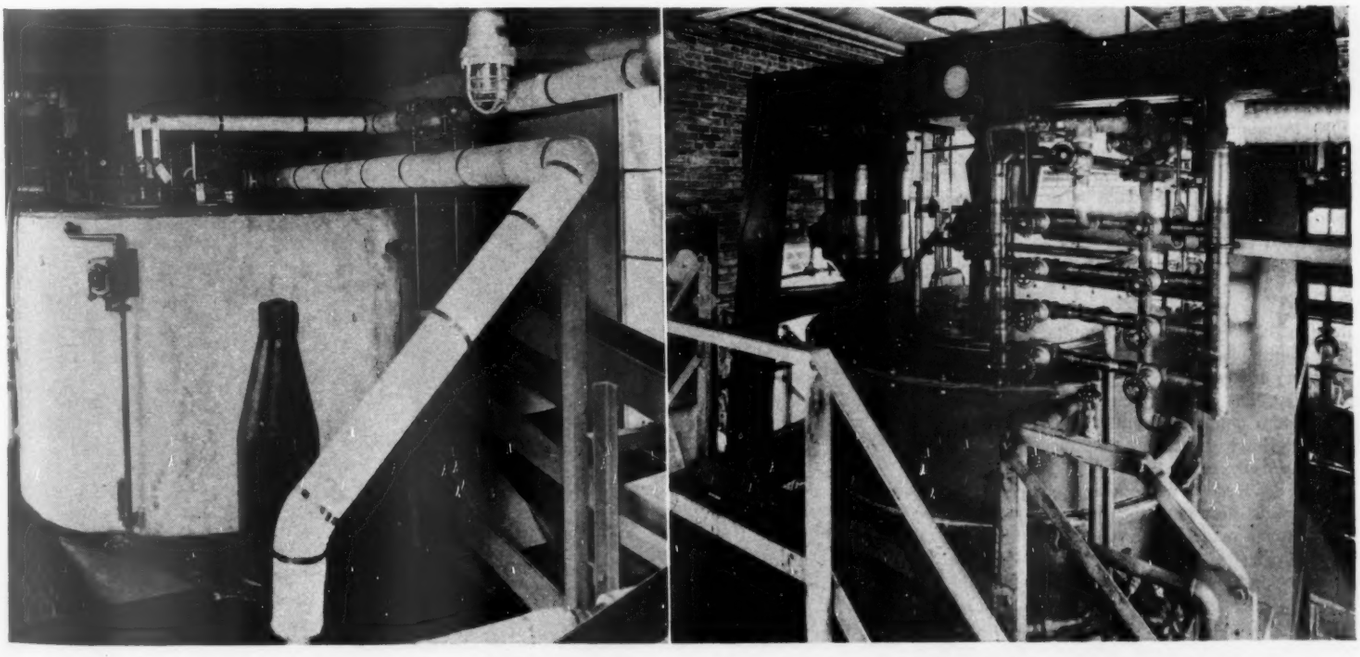

Fig. 8—(Left) 48-in. centrifuge deoiling unit. Fig. 9—(Right) 700-bbl. per day emulsion deoiling unit; showing 60-in. suspended centrifuge.

Synthetic Chemicals From Petroleum

By L. ROSENSTEIN
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THE manufacture of synthetic chemicals from petroleum and from natural gas, closely related to it, is becoming a major American industry. Petroleum is well suited as a chemical raw material: it is cheap and abundant, and contains a wide variety of chemical types which, in themselves or after cracking to simpler compounds, may be converted to derivatives of many kinds. Several general reviews of this field recently have appeared[1,2,3,4]; the present paper will be concerned largely with developments in which Shell Chemical Co. has played some part. These developments are, however, typical of the petroleum chemical industry as a whole.

At the outset a word of explanation may be in order regarding the relation of Shell Chemical Co. to its associates, Shell Oil Co., Inc., and Shell Development Co. By and large it may be said that Shell Chemical operates on raw materials which Shell Oil is in a position to furnish; and it uses processes and manufactures products which have been developed in the research laboratories and pilot plants of Shell Development. On behalf of Shell Chemical, the latter carries on extensive market research concurrently with its investigations of processing, to the end that applications may be found and markets developed for present and potential chemical products, and new products may be supplied to meet the expressed needs of industry.

In the synthetic-chemical field Shell Chemical Co. has been active both in the synthesis of alcohols, ketones, etc., from refinery cracked gases, and in the manufacture of ammonia and related products from natural gas and atmospheric nitrogen. Commercial operations were begun in 1930 with the production of secondary butyl alcohol from butylene at Martinez, Calif.; and, within a year, the synthesis of ammonia at Shell Point, near Pittsburg, Calif. Expanding operations necessitated extension of the Martinez plant in 1933 to manufacture tertiary butyl alcohol and methyl ethyl ketone, and soon thereafter at the same location a plant was built to regenerate spent alcohol acid to make it usable in manufacturing ammonium sulfate. In 1936 a large alcohol and ketone plant was built at Dominguez, near Los Angeles; and this since has been enlarged to produce acetates and higher-boiling ketones. In the first year of commercial operation about 4,500 tons of ammonia and 90,000 lb. of solvents were produced; in 1939 the corresponding figures were 27,000 tons and 57,000,000 lb. About half of the ammonia produced is converted into ammonium sulfate; and in this connection it may be noted that means have been found to use acid sludge from petroleum refining for this conversion, without impairing the quality of the ammonium sulfate produced.

The manufacture of ammonia at Shell Point begins with the cracking of natural gas over a brick checkerwork, at an average temperature of 1,100° C., yielding a gas containing 70 per cent of hydrogen, the rest being unconverted methane, with small amounts of nitrous oxide, carbon monoxide, carbon dioxide, benzene, ethylene, acetylene, and naphthalene. Most of the carbon content of the natural gas is converted to the solid form; it is separated from the crude hydrogen by washing with water and by electrical precipitation. Nitrous oxide is removed from the hydrogen by passage over iron oxide; naphthalene and benzene by washing with oil; carbon dioxide by washing with water and alkali; and light hydrocarbon impurities (methane, ethylene, and acetylene) by low-temperature fractionation, in the last stage of which liquefied atmospheric nitrogen is introduced to aid in the removal of carbon monoxide by fractionation, and to form a nitrogen-hydrogen mixture in the molecular proportions of ammonia. In the synthesis plant the last traces of carbon monoxide and oxygen are removed, and the synthesis is effected under high pressure, the ammonia emerging as a gas ready for liquefaction or conversion into ammonium sulfate.

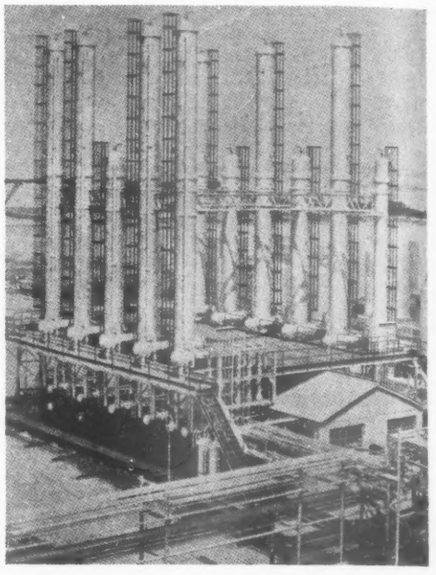

Fig. 2—Fractionating columns—Shell Chemical Co., Dominguez, Calif.

The principal application of ammonia is agricultural. When irrigation is practiced, farmers use the ammonia as a fertilizer in liquefied form. when it is carried into the soil in highly dilute solution with the water. In the form of ammonium sulfate it is used on land prior to irrigation, or on nonirrigated land. Ammonia is used also by large cities in the purification of water, in oil refineries as a neutralizing agent and cor-

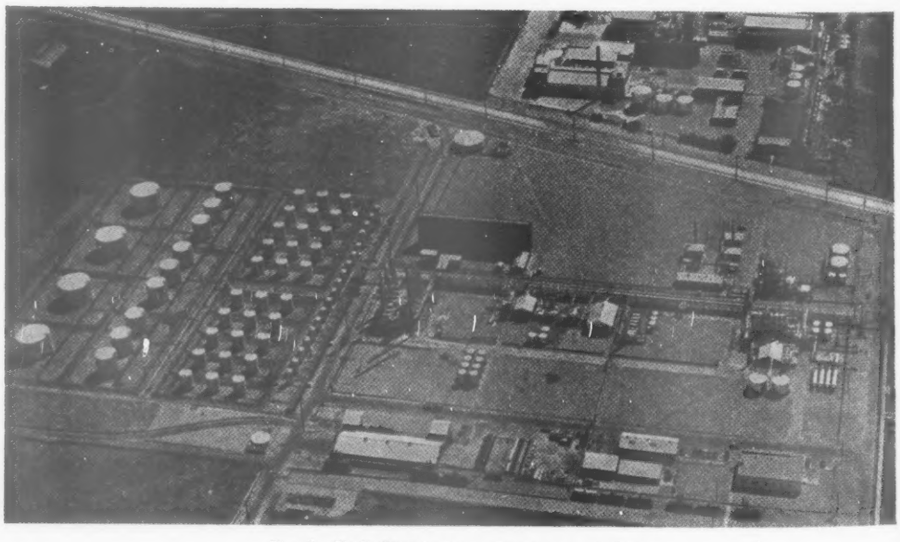

Fig. 1—Shell Chemical Co., Dominguez, Calif.

A. P. I.

The manufacture of synthetic chemicals from petroleum and natural gas has been one of the major developments in the chemical industry during the past decade. As an example, Shell Chemical Co.'s production of ammonia has increased from 4,500 tons in 1931 to 27,000 tons in 1939; of solvents from 90,000 lb. to 57,000,000 lb. in the same period. A continually increasing variety of chemicals of exceptionally high purity is being made available at constantly decreasing cost, from cheap raw materials whose supply is stable, abundant, and remarkably adaptable. Alcohols, ketones, and esters made from refinery gases that formerly were used only as furnace fuel now are known quite well to chemical markets. Many new products, now produced on laboratory and pilot-plant scale by Shell Development Co., in due course will join them. Among these are unsaturated alcohols and chlorides, glycerol and its derivatives, and butadiene.

The entrance of the petroleum industry into the field of synthetic chemicals has had a profound influence upon the development of synthetic gasolines; thus the development of isooctane was associated closely with that of secondary butyl alcohol. Other similarly close relationships may be expected as petroleum chemicals play an increasingly important part in the economics of the industry.

Paper presented before Refining Division at the annual meeting of the American Petroleum Institute, Chicago, November 11-15, 1940.

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SOUR CRUDE

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(Below) A Battery of Columbian Cop-Nic Tanks in a Sour Crude District.

TABLE 1—PROPERTIES OF PURE COMPOUNDS

Compound and chemical formula	Molecular weight	Specific gravity (20/4 °C)	Boiling point at 760 mm mercury (°C)	Melting point (°C)	Vapor pressure at 20° C (millimeters of mercury)	Flash point (closed cup) (°F)	Pounds per gallon at 20° C	Solubility with water (per cent by weight at 20° C)		Azeotrope with water	
								Compound in water	Water in compound	Boiling point (°C)	Per cent by weight of compound
Ketones											
Acetone: $CH_3.CO.CH_3$	58.08	0.7898	56.1	—95.0	186.2	5	6.59	complete	complete	....	....
Methyl ethyl ketone: $CH_3CO.C_2H_5$	72.10	0.8047	79.6	—86.4	71.2	25	6.72	27.0	12.5	73.4	88.7
Methyl isobutyl ketone: $CH_3.CO.CH_2.CH(CH_3)_2$	100.16	0.8004	115.9	—83.5	15.2	60	6.68	1.7 (25°)	1.9 (25°)	87.9	75.7
Mesityl oxide: $CH_3.CO.CH:C(CH_3)_2$	98.14	0.8546	129.5	—59	8.0	83	7.13	3.1	3.1	91.8	65.2
Diacetone alcohol: $CH_3.CO.CH_2.COH(CH_3)_2$	116.16	0.9384	166 (approximate)	—47	0.84	144 (open cup)	7.83	complete	complete	98.8	12.7
Esters											
Isopropyl acetate: $CH_3.COO.CH(CH_3)_2$	102.13	0.8719	88.6	—73.4	....	39	7.28	2.9 (25°)	2.0 (25°)	76.6	89.4
Secondary butyl acetate: $CH_3COO.CH(CH_3).C_2H_5$	116.16	0.8711	112.4	....	16.2	64	7.27	....	....	87	77.5
Alcohols											
Isopropyl alcohol: $CH_3CHOH.CH_3$	60.09	0.7848	82.3	—89.5	31.5	54	6.55	complete	complete	80.2	87.7
Secondary butyl alcohol: $CH_3.CHOH.C_2H_5$	74.12	0.8065	99.5	—114.7	12.1	73	6.73	24.4	56.0	87.5	72.7
Tertiary butyl alcohol: $(CH_3)_3.COH$	74.12	0.7791 (26°)	82.4	25.6	57.3 (30°)	48	6.50 (26°)	complete	complete	79.9	88.3
Ethers											
Isoprophyl ether: $(CH_3)_2.CH.O.CH(CH_3)_2$	102.16	0.7238	68.4	—86.8	120.2	—6	6.04	1.0	0.5	62.2	95.5

rosion preventative, and in cold-storage and ice-manufacturing equipment as a refrigerant. It is also a source of nitric acid for the manufacture of explosives, cellulose nitrate, etc.

The carbon which is left after the hydrogen has been removed from methane is processed further to meet the exacting requirements of the rubber industry. It has found wide acceptance as a soft carbon, such as is used in the compounding of rubber for hose, tubing, gaskets, and mechanical goods. That part of the carbon not suitable for this trade is made into briquettes which, because of their very low ash content and nearly zero sulfur content, have been found useful in metallurgy, more especially in steel production.

The production of alcohols, ketones, etc., from cracked petroleum gases has grown steadily in the past two decades. Thus, according to Tariff Commission reports, 37,500 gal. of isopropyl alcohol were made via the sulfation of propylene in 1922, 1,500,000 gal. in 1931, and 27,500,000 gal. in 1939. During this period the price fell steadily from $2 per gallon to 31 cents per gallon.

The process used by Shell Chemical Co. for the production of alcohols from olefins consists of:

(a) Production of pure hydrocarbon fractions containing only the olefin and its corresponding paraffin.

(b) Absorption of the olefin content in concentrated sulfuric acid to produce the alkyl hydrogen sulfates and dialkyl sulfates.

(c) Separation of the products (*b*) from unreacted hydrocarbons.

(d) Hydrolysis of the products *(b)* to either alcohols or ether in dilute sulfuric acid solution.

(e) Removal of alcohols and ethers from solutions (*d*) by distillation.

(f) Subsequent purification of alcohols and ethers by fractionation.

In this way isopropyl alcohol and diisopropyl ether are made from propylene, secondary butyl alcohol from α- and β-butylenes, and tertiary butyl alcohol from isobutylene.

Acetone is made from isopropyl alcohol, and methyl ethyl ketone from secondary butyl alcohol, by catalytic dehydrogenation and subsequent fractionation. These two alcohols also are converted to the corresponding acetates by continuous esterification processes especially developed for this purpose.

From acetone a further series of products is made: diacetone alcohol by catalytic condensation of acetone at low temperature, and subsequent fractionation; mesityl oxide by the catalytic dehydration of diacetone alcohol; and methyl isobutyl ketone by the catalytic hydrogenation of mesityl oxide.

Physical properties of these products, all made on commercial scale by Shell Chemical Co., are listed in Table 1.

The principal uses of the alcohols, ketones, and esters are as solvents and extractants in the manufacture of lacquers, varnishes, and allied products, synthetic resins, plastics, synthetic fibers, artificial leather, safety glass, photographic films, printing inks, cosmetics, medicinal preparations, explosives, etc., and also in the dewaxing of mineral oils and extraction of vegetable and animal materials.

The alcohols and ketones have found extensive use as base material for chemical synthesis to make products such as esters, chlorides, ethers, xanthates, substituted hydrocarbons, fruit essence, perfumes, dyestuffs, wetting agents, and synthetic resins. Isopropyl alcohol, because of its complete miscibility with water, is used extensively as a component of antifreeze solutions for automobile radiators.

As a particular example of these olefin derivatives, let us consider methyl ethyl ketone—which until recently was available commercially only as a component of "light acetone oil," a byproduct of the wood-distillation industry. This mixture was limited in quantity and of uncertain composition, and never found extensive industrial uses. Since the introduction of synthetic methyl ethyl ketone from petroleum, a pure product of uniformly high quality, it has been consumed in increasing quantities by a variety of industries. For instance, it is an excellent solvent for nitrocellulose, with good tolerance toward the other materials that are used in lacquer manufacture, and in many of its properties it excels the esters as a lacquer solvent. It is also an exceptionally good solvent for the highly polymerized vinyl-type resins. It is used as a paint remover, an extractant in various applications, and a dewaxing agent for mineral oil. It finds extensive use in

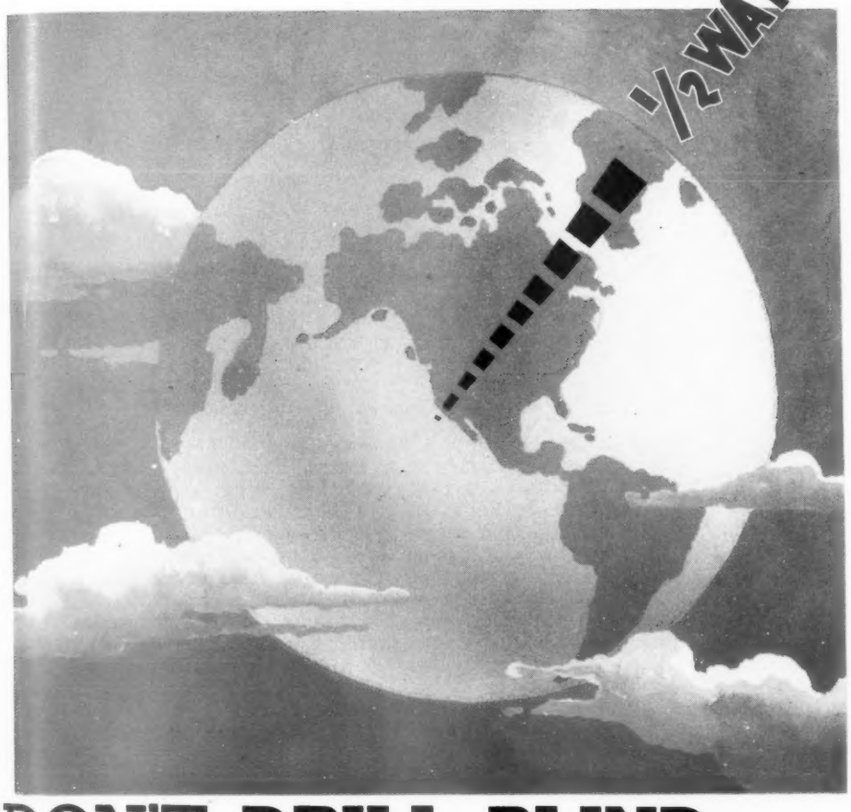
(Continued on Page 136)

TABLE 2—DERIVED CHEMICALS FROM OLEFINS BY CHLORINATION

Name	Formula	Molecular Weight	Boiling Point (Deg C)	Specific Gravity (20/4 Deg C)	Flash Point * (Deg F)	Solubility in Water (Per Cent by Weight at 20 Deg C)
Allyl alcohol	$CH_2=CH-CH_2OH$	58.08	97	0.852	70	∞
Methallyl alcohol	$CH_2=C(CH_3)-CH_2OH$	72.10	114	0.852	90	20
Allyl chloride	$CH_2=CH-CH_2Cl$	76.53	45	0.937	—25	<0.1
Methallyl chloride	$CH_2=C(CH_3)-CH_2Cl$	90.56	72	0.926	10	<0.1
Isocrotyl chloride	$CH_3-C(CH_2)=CHCl$	90.56	68	0.919	35	<0.1
1,2,3-trichloropropane	$CH_2Cl-CH(Cl)-CH_2Cl$	147.45	156	1.391	170	<0.1
Diallyl ether	$CH_2=CH-CH_2-O-CH_2-CH=CH_2$	98.14	95	0.808	20	0.3
Dimethallyl ether	$CH_2=C(CH_3)-CH_2-O-CH_2-C(CH_3)=CH_2$	126.19	134	0.816	15	<0.1
Glycerol α-monochlorohydrin	$CH_2OH-CH(OH)-CH_2Cl$	110.55	213	1.320	280	∞
Glycerol dichlorohydrin	$CH_2Cl-CH(Cl)-CH_2OH$	128.99	182	1.362	200	13
Epichlorohydrin	$CH_2Cl-CH(O)-CH_2$	92.53	117	1.181	90	

* ASTM open cup.

19,000,000 FEET OF DRY HOLE DRILLED LAST YEAR!



THE constant search for new oil reserves means an annual waste of time, effort, and billions of dollars when the result is dry holes. Dry holes drilled during preceding twelve months total over 19,000,000 feet—3,636 miles, nearly half way through the world. Each year the oil industry "buries" these mistakes to the tune of some $108,000,000. But let's look at G.S.I.'s record in seismology and soil analysis, for only by what a company accomplishes for others can you determine what they may accomplish for you. 137 producing fields are located on structural anomalies indicated by G.S.I. prior to drilling. This is the greatest number of successes accredited to *any* consulting company . . . greatest by more than *two to one*. It pays to consult a geophysical service capable of giving accurate reports and interpretations. The reasonable cost is negligible when compared to the thousands that may be made or saved. G.S.I. reports are based upon the cumulative knowledge gained in 157 crew years of experience, the longest in the industry.

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WELL LOGS and FIELD DATA . . . . of Active Oil Areas

South Central Oklahoma

(Compiled by The Oil and Gas Journal)

LOCATION: South Central Oklahoma, in the Washita and Red River valleys, bordering Grayson, Cooke, and Montague counties, North Texas.

COMMUNICATIONS: Railways: Three main lines cross the district from north to south, connecting principal cities in Oklahoma and Texas. Branch lines serve the area from east to west, the Frisco and Rock Island in Oklahoma, the Missouri-Kansas-Texas and other lines in Texas.

The area has a network of excellent state and federal highways, mostly paved or gravelled.

The larger towns, such as Ardmore, Denison, Sherman, and Gainesville, have airports. Landing fields are available at smaller towns.

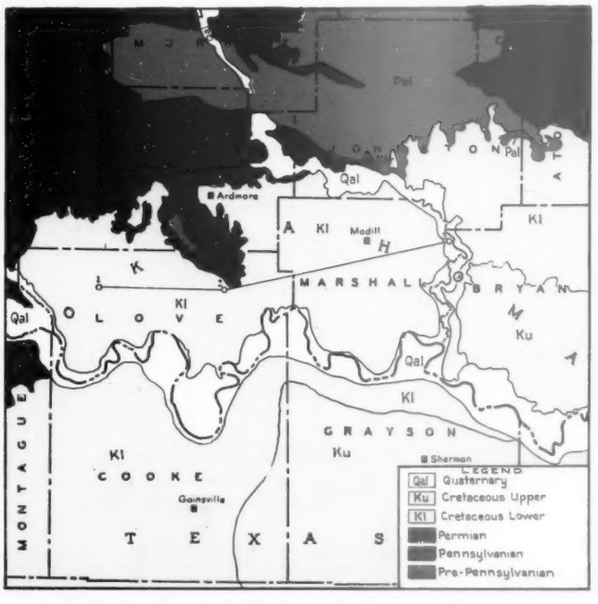
TOPOGRAPHY: The area generally is a rolling country, with lowlands in the Red River Valley. Small foothills of the Arbuckle mountains are in the northern part of the Oklahoma sector, giving way to more level land as the Red River is approached. In places, low hills border the Red River on the Texas side, but generally the Texas side is a gently rolling countryside turning into upland prairies at the south.

TOWNS: The principal towns (with population in thousands) are: Oklahoma—Ardmore, 18; Durant, 8; Madill, 3; Marietta, 2; Texas—Denison, 15; Sherman, 18; Gainesville, 9.

SUPPLY HOUSES: Ardmore, long a center of oil activity in Oklahoma, has numerous supply and equipment houses, as have the oil-field towns of Wilson and Healdton, in Carter County. Supply houses have been opened at Madill since the discovery of the Cumberland pool. The oil fields of Cooke County, Texas, are served by supply houses at Gainesville.

DEVELOPMENT: Carter County is one of the older and major oil-producing counties in Oklahoma, its greatest development starting with the discovery of the Healdton field in 1913. Production at Healdton is found in several sands and limes in upper Pennsylvanian, Glenn, Healdton zone and Ordovician horizons. Nearly a score of additional pools have been developed in the western part of the county. That Carter County still offers possibilities for exploration is shown by the recent discovery of the West Hewitt pool, now the busiest single area in Oklahoma. The Madill pool was opened in Marshall County in 1906, producing from Trinity and Caney pays at 402-1,450 ft. The Enos pool in the southern part of Marshall County, opened in 1916, produces from the lower Trinity at around 450-600 ft. The nearby Isom Springs and Kingston pools produce from shallow sands, but it was not until the recent discovery of the Cumberland pool in western Marshall that efforts to find deep production in the county was successful. The first oil was found in Bryan County several weeks ago when the Cumberland pool was extended across the Washita River. The deep Stockton pool northwest of Marietta, and a single-well shallow pool northeast of Marietta, provide the only developed production in Love County.

On the Texas side, the Walnut Bend pool in Cooke County is a comparatively recent development. Several other productive areas have been opened in the county, the principal ones being the Anderson-Kerr and Muenster pools. The Collinsville pool in Grayson County and the Nocona and St. Jo areas in Montague County are productive, but these counties as a whole still are in the wildcat class.



Geological Map of South Central Oklahoma

GEOLOGY: Structurally, the area surrounding Marshall and Bryan counties is very complicated. South of the Arbuckle Mountains the basin dips steeply to the southwest, but traversing it longitudinally there is a complex series of closely folded ridges. Dips are steep on the flanks of these ridges.

The principal movements which governed the direction of the trends preceded the Pennsylvanian period so that the Pennsylvanian series consists of very irregular deposits of sediments which were laid down on a highly irregular sea floor. For this reason correlations are difficult within the Pennsylvanian and individual beds grade rapidly lithologically so that a pay in one field may not be represented even by a few sandy streaks a few miles away.

The pays are divided into two main groups, the irregular lenticular Pennsylvanian sands of which several may be productive on a single structure and the more uniform pre-Pennsylvanian pays such as the Viola and Simpson.

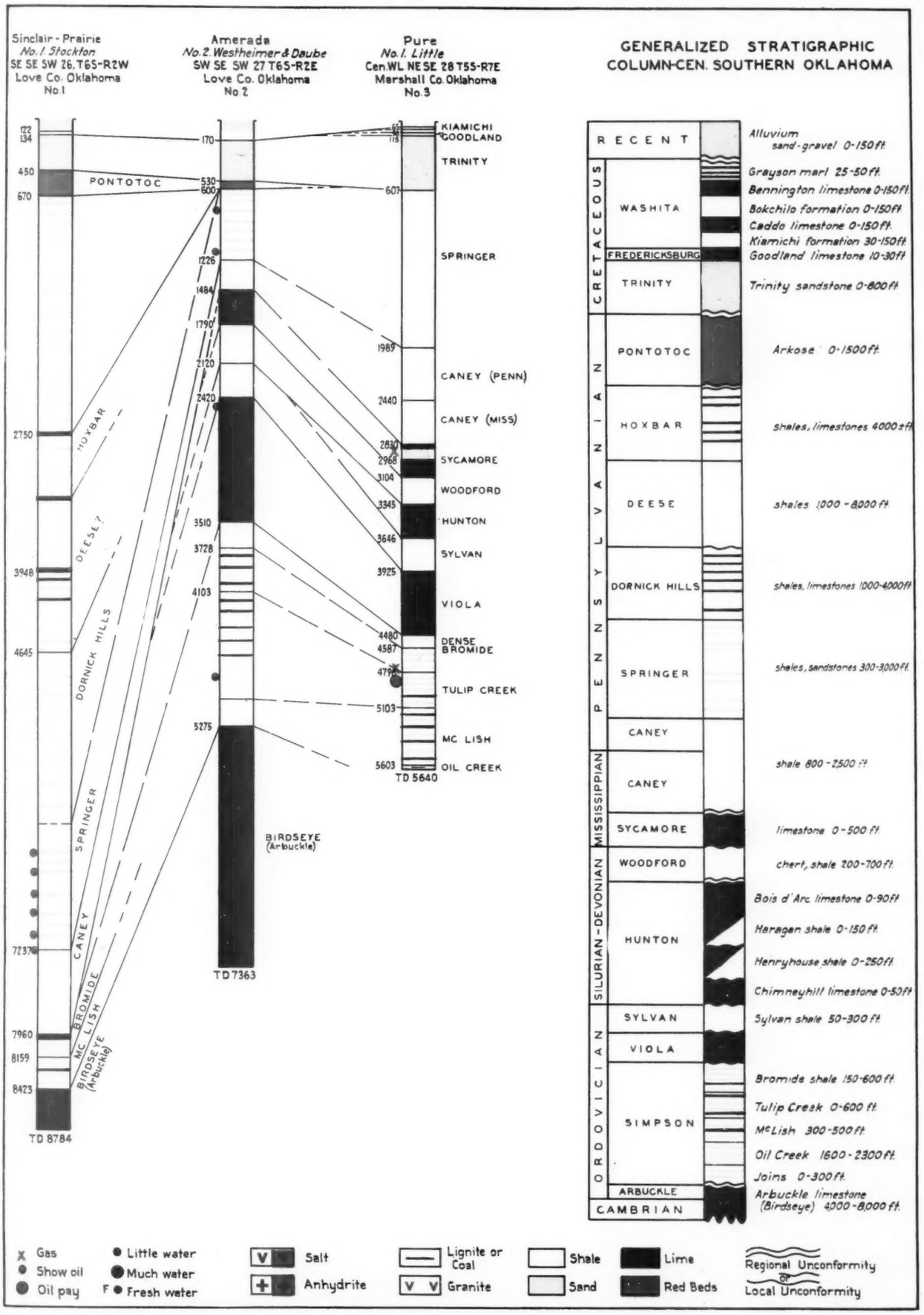
POTENTIALITIES: Some of the Carter County fields have an estimated ultimate recovery of between 25,000 and 30,000 bbl. per acre from Pennsylvanian and lower Paleozoic pays. Early estimates of the Simpson production in the Cumberland field were 30,000 bbl. per acre. Pennsylvanian production of Nocona and other neighboring North Texas fields is placed at 7,500 to 9,500 bbl. per acre.

The production up to date has come largely from the flanks of the basin and even these pools are not fully prospected. There is no reason for believing that structures in the deeper parts of the basin will not be equally productive.

WATER: Supplies of surface water are plentiful in much of the district, with numerous small streams emptying into the Red and Washita rivers. There are several artificial lakes in the area, and water can be found in wells at a comparatively shallow depth.

FUEL: Natural gas is plentiful and available throughout the greater part of the area.

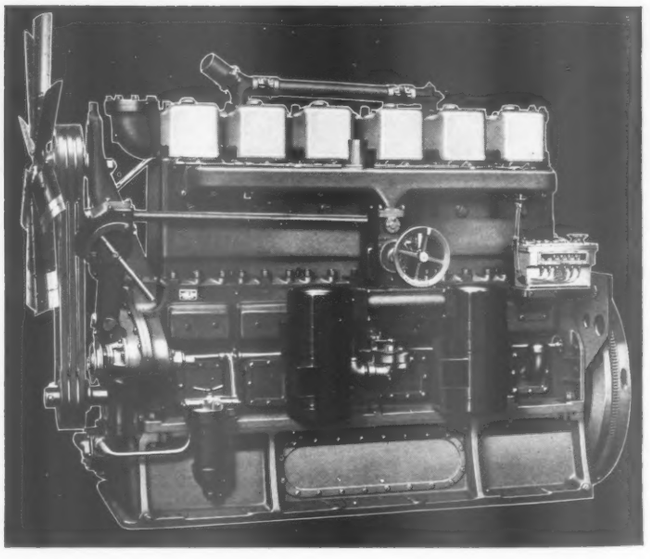
ELECTRIC POWER: Power is available at all of the principal towns, and high lines traverse the district.


Sinclair - Prairie
No. 1 Stockton
SE SE SW 26, T6S-R2W
Love Co. Oklahoma
No. 1
Amerada
No. 2 Westheimer & Daube
SW SE SW 27 T6S-R2E
Love Co. Oklahoma
No. 2
Pure
No. 1 Little
Cen. WL NE SE 28 T5S-R7E
Marshall Co. Oklahoma
No. 3
122
134
450
670
PONTOTOC
2750
HOXBAR
DEESE?
3948
DORNICK HILLS
4645
SPRINGER
7237
CANEY
BROMIDE
MC LISH
7960
8159
BIRDSEYE (Arbuckle)
8423
TD 8784
170
530
600
1226
1484
1790
2120
2420
BIRDSEYE (Arbuckle)
3510
3728
4103
5275
TD 7363
KIAMICHI
GOODLAND
TRINITY
607
SPRINGER
1989
CANEY (PENN)
2440
CANEY (MISS)
2830
2968
SYCAMORE
3104
WOODFORD
3345
HUNTON
3646
SYLVAN
3925
VIOLA
4480
4587
DENSE
BROMIDE
TULIP CREEK
5103
MC LISH
5603
OIL CREEK
TD 5640
GENERALIZED STRATIGRAPHIC COLUMN-CEN. SOUTHERN OKLAHOMA
RECENT
Alluvium sand-gravel 0-150 ft.
CRETACEOUS
WASHITA
Grayson marl 25-50 ft.
Bennington limestone 0-150 ft.
Bokchito formation 0-150 ft.
Caddo limestone 0-150 ft.
Kiamichi formation 30-150 ft.
FREDERICKSBURG
Goodland limestone 10-30 ft.
TRINITY
Trinity sandstone 0-800 ft.
PENNSYLVANIAN
PONTOTOC
Arkose 0-1500 ft.
HOXBAR
shales, limestones 4000± ft.
DEESE
shales 1000 - 8000 ft.
DORNICK HILLS
shales, limestones 1000-4000 ft.
SPRINGER
shales, sandstones 300-3000 ft.
CANEY
MISSISSIPPIAN
CANEY
shale 800 - 2500 ft.
SYCAMORE
limestone 0 - 500 ft.
WOODFORD
chert, shale 200 - 700 ft.
SILURIAN-DEVONIAN
HUNTON
Bois d'Arc limestone 0-90 ft.
Haragan shale 0-150 ft.
Henryhouse shale 0-250 ft.
Chimneyhill limestone 0-50 ft.
ORDOVICIAN
SYLVAN
Sylvan shale 50-300 ft.
VIOLA
SIMPSON
Bromide shale 150-600 ft.
Tulip Creek 0-600 ft.
McLish 300-500 ft.
Oil Creek 1600 - 2300 ft.
Joins 0-300 ft.
ARBUCKLE
Arbuckle limestone (Birdseye) 4000 - 8,000 ft.
CAMBRIAN
Gas
Show oil
Oil pay
Little water
Much water
F Fresh water
Salt
Anhydrite
Lignite or Coal
Granite
Shale
Sand
Lime
Red Beds
Regional Unconformity
or
Local Unconformity

California Pioneers Again...

a 1000 hp. Butane Drilling Unit with

WAUKESHA ENGINES



California again makes drilling history . . . with this latest rig built by National Supply Co., for Bell & Loffland, well known drilling contractors. For this 10,000-ft. drilling rig, B & L, who have had many years of successful experience with Waukesha Engines, selected three Waukesha Model 6-LRO Engines, having a maximum output of 375 hp. each.

Burning natural gas or butane, and equipped with hydraulic couplings, these Waukesha drilling engines operate over a wide speed range, with the high torque characteristics of steam as well as steam's flexibility, smoothness and responsiveness. Adjustment of torque-speed to power demand is automatic.

A unique feature of this 3-engine hook-up permits the use of two engines for hoisting, while one can be held in reserve for running a mud-mixing pump or for other duties. When drilling, No. 1 engine can operate the table, while No. 2 engine is free to drive one power pump, and No. 3 engine the other. Each pump may be operated separately, at any desired speed, for routine drilling; or be connected up in a series or in parallel for tougher drilling . . . a flexibility not obtained with the conventional method of driving both pumps from the same countershaft.

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Economics of Controlling Water Produced With Oil

By J. U. TEAGUE
Hogg Oil Co., Houston, Tex.*

THE purpose of this paper is to discuss the various factors which should be considered when deciding whether it is economical to perform remedial work to exclude the water from oil wells which are producing a percentage of water, and what statistical data and other information should be accumulated to evaluate these factors. The discussion will be as general as possible, as conditions will vary so much between fields, or even wells, that specific recommendations would be of little value.

The decision to perform remedial work on wells producing water with the oil is not arrived at easily if it is to be justified on a cost basis and, with the steadily declining allowable rates of production from each well, it becomes increasingly important that a satisfactory return on all major well expense or investment be assured before the work is commenced. This return may be in the form of lowered operating costs because of not having to lift the water in addition to the oil, or because of less tangible benefits such as conservation of reservoir energy and greater ultimate recovery of oil through the more efficient utilization of water encroachment.

The major considerations in deciding on a program of remedial work to exclude water from oil wells discussed in this paper are:

1. Physical characteristics of the reservoir.
2. Effect of water production on reservoir energy and ultimate recovery.
3. Means of determining the source of water.
4. Types of remedial work in common use.
5. Increased operating costs due to production of water with the oil.
6. Disposal of the water produced.

Physical Characteristics of Reservoir

The physical characteristics of the reservoir most easily are determined, at the time the wells are being drilled, by an analysis of the cores taken from the producing horizon supplemented by electrical-log information and possibly mud analyses. These characteristics are essential not only to the subsequent identification and control of water which might appear in the wells, but to the proper initial completion of wells. These characteristics are:

1. Gas-oil contact.
2. Water-oil contact.
3. Thickness of productive zone.
4. Effective porosity of the producing formation.
5. Stratigraphic variation in permeability of the producing formation.
6. Percentage of oil and connate-water saturation.
7. Amount of recoverable oil present in a unit volume of the producing formation.

From this information the well can be completed in such a manner as to give the longest productive life free of water. From this information also can be determined, to a large extent, the most effective remedial method to be used when water does appear, if it is desired to exclude the water.

As an example, a well completed in a reservoir which has a good horizontal permeability but a poor vertical permeability could be completed nearer the water-oil contact, without fear of the water coming upward and entering the well prematurely, than a well completed in a reservoir which had both a high vertical and horizontal permeability or no impermeable sections to retard the upward migration of oil and water. It probably would be desirable to complete the well having a high horizontal permeability and low vertical permeability near the water-oil contact to assure adequate drainage of the lower sections of the reservoir. When water appeared and conditions justified, the water could be shut off and the well recompleted as near the new water level as desired. Experience in the particular field, and close analysis of the information, would dictate how much formation could be closed off for the remedial work to give a maximum producing life free of water and a minimum of trapped nonrecoverable oil. Generally speaking a water shutoff can be obtained with much more assurance in a reservoir which contains impervious or highly impermeable lenses interbedded with the effective oil-producing section than in one which has a homogeneous producing section with a uniform vertical and horizontal permeability.

The foregoing example illustrates the important position occupied by certain types of information which can be obtained only during the drilling and completion of the wells, when determining

*This paper sponsored by the southwestern district topical committee on production practice, Division of Production, American Petroleum Institute.

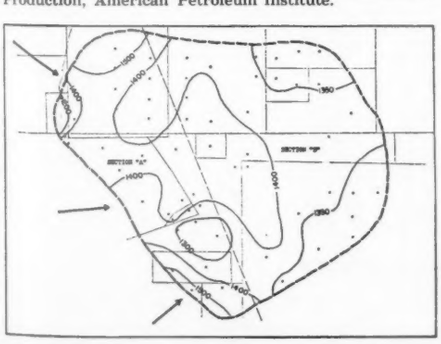

Fig. 1—Isobaric map of salt-dome field with strong water drive from north and west

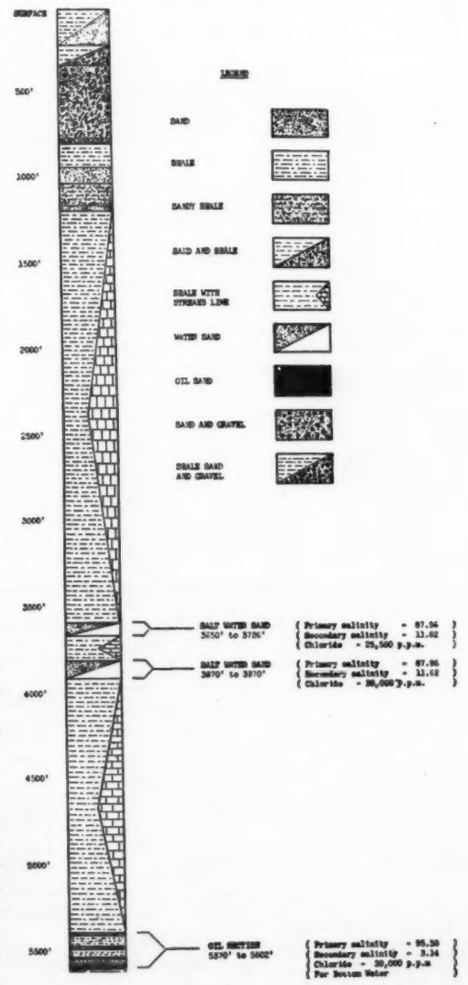

Fig. 2—Typical Gulf Coast well log showing analyses of water from different horizons

A. P. I.

The economics of doing remedial work to exclude the water from wells producing water and oil is a problem of serious concern to the operator.

The production of water in some fields is, no doubt, injurious to the oil-producing reservoir, and should be excluded to conserve reservoir energy and increase ultimate recovery. In many other fields there is no apparent damage to the reservoir by the production of water, and any remedial work done must be justified by the saving in operating cost resulting from not having to lift the water and then dispose of it.

The principal factors that should be considered in determining the economics of remedial work are:

(1) Physical characteristics of the reservoir. (2) Effect of water production on reservoir energy and ultimate recovery. (3) Means of determining the source of water. (4) Types of remedial work in common use. (5) Increased operating costs due to production of water with oil. (6) Disposal of water produced.

It is important that the statistical data and information necessary to evaluate these factors be accumulated prior to the time the production of water becomes acute and a decision on remedial work must be made.

Paper presented before Division of Production at the annual meeting of the American Petroleum Institute, Chicago, November 11-15, 1940.

the nature and extent of remedial work required in the future to obtain maximum performance from the reservoir.

Unfortunately most of the fields which now are producing large quantities of water with the oil, and which are of immediate concern, were developed prior to the time core analyses and electrical logging were in general use. Consequently, the data on the physical characteristics of the reservoirs are very meager, and will be of small help in dealing with the immediate problems. The importance of this information has been emphasized, however, to encourage the accumulation of basic data on the oil-producing reservoir, which data will be needed to analyze future production problems at the time such data most readily can be obtained.

Effect of Water Production on Reservoir Energy and Ultimate Recovery

The effect of the production of water in quantity from a reservoir, together with the desired or, more aptly, the allowed production of oil on the reservoir energy, has been discussed at length by various authors. It has been pointed out by competent authorities on reservoir energy that the production of a barrel of water from the reservoir may have the same effect on reservoir energy as the production of a barrel of oil.[1]

TABLE 1—COST OF EXCLUDING WATER FROM WELLS IN CONROE FIELD

	Column "A" Light drilling rig		Column "B" Well-servicing unit	
Well	Cost	Results	Cost	Results
A	$9,933	Clear	$3,504	Clear
B	8,256	Clear	3,747	Clear
C	4,940	Clear	4,913	Clear
D	5,404	Clear	3,821	Clear
E	5,904	Clear	3,143	Clear
	32 wells plugged by this method.		6 wells plugged by this method.	
Method	Pulled screen, placed cement plug, reset screen.		Gun-perforated bottom of screen, squeezed with cement, gun-perforated screen above plug.	

The effect of the production of large quantities of water from some reservoirs which have a water drive to assist in the maintenance of bottom-hole pressure will be to accelerate the rate of decline of bottom-hole pressure to such an extent that a reasonable expenditure for remedial work to reduce the quantity of water produced would be justified to conserve the reservoir energy.

In other reservoirs the production of oil and water together will not exceed the rate of production at which the water drive can maintain the bottom-hole pressure at a satisfactory level, and there will be no apparent damage to the reservoir energy by the production of the water.

TABLE 2—HISTORY OF WELLS PLUGGED BACK TO EXCLUDE WATER—CONROE FIELD

Wells	Salt water: Before work (Per cent)	Salt water: After work (Per cent)	Salt water: At present (Per cent)	Top plug above original water-oil contact (feet)	Months since work	Months producing water	Months life of work
A	17	0	3	29	76	49	27
B	16	0	0	61	63	0	...
C	9	0	0	88	62	0	...
D	38	0	17	43	62	20	42
E	31	0	0	89	62	0	

In these fields a program of remedial work could not be justified on the basis of conservation of reservoir energy.

No doubt there are many fields producing substantial quantities of water with the oil which fall in each group. Many of the larger fields—particularly in the Texas Gulf Coast area, which are drilled on a wide-spacing pattern and which have very low allowable rates of daily oil production per well—will be able to produce comparatively high percentages of water without any detrimental effect on the reservoir energy, insofar as it can be determined by the decline in bottom-hole pressures.

It is desirable that bottom-hole-pressure surveys be made at frequent intervals to determine the effectiveness of the water drive, if it exists in a field, and its performance at different rates of production.

In addition to its function of maintaining reservoir energy, an active water drive properly controlled is of decided importance in increasing the ultimate recovery of oil from the reservoir.

Comparative data for secondary-recovery projects indicate that water flooding is from 200 to 400 per cent more effective than gas repressuring. In fields which enjoy an active water drive, water flooding is accomplished by natural encroachment. If the same control is exercised over natural encroachment of water as would be exercised in intentional water flooding, then an increase in the ultimate recovery of oil can be expected.

The effective control of water encroachment must deal with the reservoir as a whole. A single property improperly operated may spoil the results of an otherwise ideally operated field. For example, Fig. 1 is the isobaric map of a typical nonpiercement-type salt-dome structure which has a strong water drive from the north and west, as indicated by the arrows. Assume this reservoir is able to maintain its bottom-hole pressure uniformly throughout at a certain rate of production. If the edge leases in section *A*, which lie directly in the path of the water drive, are permitted to produce a large volume of water in addition to the allowable oil production, then the leases upstream in section *B* will not receive the benefits of the normal water drive—thus resulting in decreased bottom-hole pressures and lower recovery of oil. If this field was in the pumping stage and depended on the water drive to maintain the fluid levels in the wells, the excessive water production in section *A* could be expected to result in lowered fluid levels with correspondingly greater lifting costs and probably lower ultimate recovery of oil in section *B*.

In such cases it might prove justifiable to shut in completely the wells in section *A*. If conditions warrant, the wells could be worked over to exclude the water, justifying the cost of the work by the increased efficiency of production and ultimate recovery of oil on the leases upstructure in section *B*.

It is realized fully that such control over the operations of different leases in a field of diversified ownership is not always possible, but it is a goal to work toward if the greatest production efficiency and maximum recovery are to be realized. This goal can be reached only by closer cooperation between operators, unitization of fields, or by proper state regulatory bodies.

It should be pointed out further that, although from a purely theoretical standpoint it might be desirable in some cases to eliminate all water production in the interest of greater production efficiency, the beneficial results of such action must be weighed carefully against the cost. If a maximum degree of production efficiency is attained, but at a cost exceeding the probable return, then the primary object of making a reasonable profit on the money invested has been defeated.

Method of Determining Source of Water

Determination of the source of water entering the well is a prerequisite to applying remedial control. The water produced by the well may be native to the producing formation, or may be the result of a faulty completion or mechanical defect in the well equipment which permits the water to enter the well from some formation above or below the producing zone. In a number of cases water occurs within the productive zone itself, especially when the productive zone is thick. Wells completed higher structurally, and much higher above the normal water-oil contact, often

TABLE 3—MONTHLY OPERATING-COST SUMMARY OF FOUR SALT-WATER DISPOSAL SYSTEMS IN LOUISIANA

Period—	District A: Monthly injection (barrels)	District A: Monthly operating cost	District A: Cost per injected barrel	District B: Monthly injection (barrels)	District B: Monthly operating cost	District B: Cost per injected barrel	District C: Monthly injection (barrels)	District C: Monthly operating cost	District C: Cost per injected barrel	District D: Monthly injection (barrels)	District D: Monthly operating cost	District D: Cost per injected barrel
May 1939	316,275	$2,910.35	$0.009201	204,384	$519.63	$0.002542	.....	.....	.....	37,240	$125.83	$0.003379
June 1939	322,430	1,256.00	0.003895	203,250	703.89	0.003463	71,532	$4.26	$.000059	41,153	113.47	0.002757
July 1939	302,280	1,344.07	0.004446	171,496	1,047.44	0.006108	76,167	52.25	0.000686	*50,500	*1,200.00	*0.023762
August 1939	195,205	1,256.39	0.006433	152,174	425.48	0.002796	62,531	84.45	0.001350	50,542	49.57	0.000981
September 1939	186,158	886.31	0.004761	175,191	914.72	0.005221	80,304	2.12	0.000022	54,831	17.54	0.000320
October 1939	133,682	882.09	0.006598	224,104	3,576.25	0.015957	94,639	33.90	0.000358	55,759	5.36	0.000096
November 1939	310.201	1,502.03	0.004842	292,501	970.46	0.003318	91,938	57.92	0.000629	61,613	164.48	0.002669
December 1939	318,695	1,708.82	0.005362	229,920	234.60	0.001019	115,025	163.86	0.001424	64,582	16.05	0.000248
January 1940	267,095	605.53	0.002267	188,928	389.72	0.002062	128,233	61.22	0.000477	65,415	37.03	0.000566
February 1940	216,603	1,085.01	0.005009	238,256	211.60	0.000888	124,961	168.27	0.001346	59,928	19.18	0.000320
March 1940	263,136	1,357.49	0.005159	244,943	230.15	0.000942	130,798	91.99	0.000662	60,854	42.64	0.000701
April 1940	252,235	991.92	0.003933	224,084	232.66	0.001034	145,036	93.50	0.000645	55,751	15.41	0.000276
Total for 12 months	3,084,075	15,786.01	$0.061906	2,550,301	$9,456.72	$0.045350	1,129,164	$813.83	.....	658,168	$1,806.56	.....
Averages	257,006	1,315.50	$0.005118	212,525	788.06	$0.003708	102,651	67.82	$0.00721	54,847	$150.55	$0.002745
Plant gathering-system investment	.....	$62,470.00	.....	.....	$17,733.00	.....	.....	$15,655.00	.....	No plant installation except 4 × 6 duplex pump		
Maximum capacity of plant disposal	10,000 bbl. per day			7,000 bbl. per day								

*Reperforated injection well No. 1.

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produce water before the wells completed nearer the water-oil contact and lower structurally.

This can be attributed to the close proximity of a fault plane along which the water can travel into the well, or to selective encroachment of water through more permeable sections of the productive zone. The source of the water will determine to a large extent the remedial work which must be done.

There are a number of methods of determining the source of water, a few of which are:

1. Chemical analyses of the water.
2. Use of special water-locating instruments.
3. Calculation of the rise in the water-oil contact due to withdrawal of oil.
4. Plugging and testing.

The simplest and most apparent way of determining the source of water is by comparing the salinity of the water produced from the well with that previously determined from samples native to the producing zone. If the analyses of the water from the well differ greatly from that native to the producing zone, then a leak in the casing or a faulty cement job immediately can be suspected, and further tests can be made to determine the actual point of entry of the water into the well. This emphasizes the importance of the operator having samples of water obtained from different horizons analyzed as a future aid in identifying water produced by the well. This is particularly true of water obtained on drill-stem tests, when exploratory wells are being drilled.

A typical Gulf Coast well log, with the variation of analyses of water from the different horizons, is shown in Fig. 2.

There are numerous devices being developed and available on the market—such as photoelectric cells, electrical logs, and electrical thermometers—that meet with varied success in locating the source of water entering the well bore. The results obtained from the use of these instruments are promising, and no doubt will come into more general use; but their description and the results obtained to date are beyond the scope of this paper. Detailed information on their operation and application can be obtained throuugh the various companies offering the services.

If the appearance of water in the well indicates a rise of the water in the reservoir due to natural water encroachment replacing the producing oil, a check can be made by calculating the amount of oil withdrawn as compared with the original amount of producible oil estimated to be in place. To make this calculation, the information obtained from core analyses, together with the amount of oil produced by the well and the decline in bottom-hole pressure, must be available. If the calculation does not present a reasonable justification for the appearance of water from natural causes, then it is reasonable to assume that the water encroachment in the section is irregular, or that the water is from some extraneous source.

The most expensive, but at the same time probably the most reliable, method of determining the point of entry of water into the well is by a successive plugging and testing of the zone under question. This method is too well known to justify further description.

Types of Remedial Work in Common Use

As has been stated, it is impractical to recommend any specific method for excluding water from a well which can be applied successfully to all conditions. Many different procedures are in current use, with good success. The method to be used will be governed by the manner of original completion and by local conditions. Probably the most popular method in use today is some form of "squeeze" cementing, which has proved highly effective in shutting off water irrespective of its point of entry into the well. Chemical plugging also is being widely investigated, and may prove effective in the future. However, the various methods of excluding water from wells in general use have been covered ably in previous publications of the American Petroleum Institute.[2]

Some operators have found that cheap and effective remedial work can be accomplished by doing a squeeze job using light well-servicing squipment. A comparison of the cost of this type of remedial work with other methods to exclude bottom water from wells in the Conroe field is given in Table 1.

The jobs shown under column "A" were straight plug-backs which involved the use of a light drilling rig. These jobs were performed some 5 years ago. Under column "B" are recent "squeeze" jobs which did not require pulling screen and could be performed using ordinary well-servicing equipment. It is estimated that similar jobs can be done in the future in this field for as little as $2,500 per well. As the technique of this work is improved, and if done in conjunction with well-servicing equipment employing a portable mast which will eliminate the erection, dismantling, and moving of a derrick, the cost of this work can be reduced still further.

The expected life of remedial work is a factor of greatest importance in considering a program involving a number of wells. This can be determined only by study of the local conditions in the field. If possible, trial remedial work should be done in advance of the time when water is expected to appear in a large number of wells, so that a proper decision can be made on a program involving large expenditures. In many cases trial work can be done in an edge well which produces, shortly after completion, large quantities of water.

The performance of the remedial work done on the wells listed under column "A" of Table 1 is shown in Table 2.

Without some information as to the expected life of the remedial work, it would be difficult to determine whether the cost of the remedial work could be paid out by savings in operating costs.

Increased Operating Costs Due to Production of Water

The production of water with oil results directly in increased investment and operating costs, apart from possible damage to the reservoir and decrease in ultimate recovery. Some of the items of operating cost affected by the production of water are:

1. Treating oil. (*a*) Chemicals or electrical treating. (*b*) Extra labor.
2. Pumping costs. (*a*) Pumping power. (*b*) Servicing power. (*c*) Labor.
3. Salt-water disposal. (*a*) Plant operation. (*b*) Water treatment.
4. Corrosive action on equipment.

Items of investment which are involved in the production of water with oil are:

1. Pumping or artificial-lifting equipment.
2. Extra tankage. (*a*) Gun barrels. (*b*) Heaters.
3. Salt-water disposal plants.

The operating cost due to production of water in some instances can be reduced appreciably by a study of the problem. As an example, in fields where the bottom-hole pressure is high the cost of installing and operating pumping equipment can be deferred by the use of small flow strings. At low rates of production the velocity of flow in the conventional 2-in. and 2½-in. tubing may be too low to carry the water entering the well to the surface, and the water will accumulate gradually in the tubing until a sufficient head builds up to prevent natural flow. This may occur although there is sufficient reservoir energy and gas in the produced oil to maintain flow, if the velocity is sufficient to carry the water out of the well at the rate it enters.

By running a string of small tubing which will increase the velocity of the flow at a given rate of production high enough to carry the water out of the well, natural flow often can be maintained for an indefinite period.

There are records of wells which made as much as 90 per cent salt water and which were taken off the pump, and these wells now are flowing naturally on 1¼-in. tubing.

The installation of small tubing is cheap, and the tubing is fully salvable; at the same time this defers the investment in pumping equipment and saves the extra operating expense of servicing the pumping well and furnishing power for pumping.

In many cases the cost of treating can be reduced greatly by a careful selection of the treating chemical which best will suit the oil produced, and by the use of efficient equipment to inject and mix the chemical into the oil.

Treating cost may be reduced further by the use of an inexpensive gun-barrel heater to maintain the emulsified oil at that temperature at which treatment to remove the water will be most effective. Proper temperature in many instances will eliminate entirely treating with chemicals.

The operating cost of producing a barrel of oil must be expected to increase even with the most efficient operations. The difference between the cost of producing a barrel of oil free of water and a barrel of oil with a quantity of water is the profit to be realized by performing remedial work to exclude the water. This difference in costs is essential to determine whether remedial work, as it affects operating costs, is justified. Therefore, accurate records of operating costs must be kept both before and after the production of water.

The cost records should be such that operating costs of individual wells can be determined as well as average lease costs.

Salt-Water Disposal

One of the major factors to be considered in deciding on remedial work to control water production associated with oil is the method and cost of disposing of salt water. The methods of disposal in common use are:

(1) Storage in open pits. (2) Periodic release into streams at flood stage. (3) Evaporation. (4) Underground injection.

The first three methods are more effective if the operator is located near enough to the coast to dispose of the water at or near tide water.

The most effective method of disposing of large quantities of salt water is by injection into subsurface salt-water sands when conditions will permit. In some of the Gulf Coast areas of Texas and Louisiana satisfactory rates of injection can be obtained with no more equipment than a pump and an abandoned well perforated opposite a known salt-water sand. In many cases, after injection once has been started, the water will continue under a gravity head, handling up to several thousand barrels of water per day without the assistance of a pump.

In other cases, and particularly in the Mid-Continent area, the water must be filtered and in some instances treated to remove additional minerals before injection, to avoid plugging the sand face of the injection well.[3] These plants, if designed to handle large quantities of water, require a large investment; and it should be understood definitely that in some fields water cannot be disposed of successfully through input wells.

To determine the size and type of disposal plant which will be required for a particular field, com-

plete information on the subsurface zones suitable for injection and the nature of the water native to the zone as well as that to be injected must be available.

This information can be obtained by picking the most promising zones from electrical or drillers' logs of previous wells drilled in the field; then, as a new well is drilled, the different zones can be drill-stem tested to obtain samples of water for analysis. The bottom-hole-pressure chart obtained with the drill-stem test will give the bottom-hole pressure and some indication of the performance of the zone as an injection well.

It may be desirable and practical to dispose of the water through edge injection wells in the producing zone itself. This should serve the double purpose of water disposal and pressure maintenance.

The cost of installing and operating salt-water disposal plants in four fields in southern Louisiana is given in Table 3. The plants range from an elaborate installation for filtering, treating, and injecting 10,000 bbl. per day to the simplest installation involving only an accumulation pit and injection pump.

Outline of Records and Data Necessary for Analysis of Problem

Members of the topical committee on production practice have made numerous suggestions in their communications on the subject relative to the records and data which they consider essential for proper analysis of the economics of remedial work to exclude water. These suggestions are presented in outline form:

1. Individual well data.

A. Geological data

(1) Driller's log. (2) Electrical log. (3) Top of producing zone. (4) Thickness of producing zone. (5) Gas-oil contact. (6) Water-oil contact. (7) Core analyses: (*a*) Permeability of producing section (*b*) Porosity of producing section; (*c*) Oil and connate-water saturation. (These data may not be necessary on every well, especially on inside wells drilled in a field whose subsurface conditions are known.)

B. Completion data

(1) Casing-seat depth. (2) Amount and method of cementing oil string. (3) Screen setting, if any, and formation screened. (4) Gun perforations, if any, and formation perforated. (5) Production packers, if any; type and depth set. (6) Complete record of any special completion technique, such as use of acid, shooting, special chemical for removal of mud cake. (The first four items usually can be recorded graphically by diagram of the well setting.)

C. Production data

(1) Initial production: (*a*) Gas-oil ratio; (*b*) Oil per day; (*c*) Casing and tubing pressure; (*d*) Method of production—natural flow, gas lift or pumping. (2) Appearance of water: (*a*) Date of appearance; (*b*) Percentage of water produced; (*c*) Analysis of water; (*d*) Rate of increase in percentage of water. (3) Cumulative oil and water production of well. (On large leases, when a number of wells are producing, the cumulative production will have to be approximated from individual well tests made periodically.) (4) Any expenditures on wells attributed to production of water: (*a*) Material; (*b*) Labor.

D. Remedial work done to exclude water

(1) Type of work done. (2) Formation excluded above original water-oil contact. (3) Results of work. (4) Cost of remedial work. (5) Date of reappearance of water.

(Continued on Page 135)

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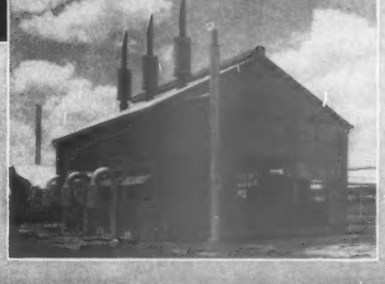

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E. Operating cost

(1) While well produced pipe-line oil: (*a*) Natural flow; (*b*) Gas lift; (*c*) Pumping. (2) While well produced oil and water: (*a*) Natural flow; (*b*) Gas lift; (*c*) Pumping. (The operating cost on individual wells will have to be approximated on leases having a large number of producing wells, but should be reasonably accurate if care is exercised in making the estimate.)

2. Reservoir data.

A. Geological

(1) Type of structure. (2) Average gas-oil contact. (3) Average water-oil contact. (4) Average thickness of productive formation. (5) Average characteristics of productive zone: (*a*) Permeability, both horizontal and vertical; (*b*) Effective porosity; (*c*) Oil and connate-water saturation. (6) Location of faults and other structural features.

B. Reservoir energy

(1) Type of drive: (*a*) Water drive; (*b*) Gas drive. (*c*) Both. (2) Bottom-hole-pressure-decline curve: (*a*) Established by periodic surveys on all wells or key wells; (*b*) Pressure information also can be presented by isobaric maps. (3) Cumulative production curve. (4) Cumulative water-production curve. (5) Periodic water-production maps. (Wells producing water and percentages of water produced are shown on map to present both the rates of water encroachment and the distribution of water production.) (6) Gas in solution in the oil in the reservoir. (This information obtained from bottom-hole sample, and is needed in estimating recoverable oil.)

The Curves 2, 3, and 4 will determine the effect of the production of water on the bottom-hole pressures.

3. Cost of producing water.

A. Average lifting cost for lifting pipe-line oil.
B. Average lifting cost for lifting oil and water.
C. Investment costs to handle water. (1) Artificial lifting equipment. (2) Extra tankage. (3) Other equipment.

4. Salt-water disposal.

A. Analysis of water from horizon adjacent to producing zone.
B. Analysis of water from producing zone.
C. Data on zones suitable for water injection.

Conclusion

If this paper will stimulate interest in this important subject and encourage further study, it will serve a useful purpose.

Acknowledgment

The southwestern district topical committee on production practice desires to acknowledge the contributions from members of the topical committees on production practice in the other districts in the preparation of this paper, particularly from E. K. Parks, California consulting engineer, and R. J. Sullivan, of Carter Oil Co., Mattoon, Ill. Especial acknowledgment for their helpful criticisms is due to M. B. Thomas, of Humble Oil & Refining Co.; Harold Decker, of Seaboard Oil Co.; Paul D. Torrey, of Sloan & Zook Co.; Ralph Schilthuis and L. W. Storms, of Humble Oil & Refining Co.; and for their active assistance in the preparation of the paper to Douglas Ragland and R. E. Bridges, both of Humble Oil & Refining Co.

References

1. S. E. Buckley, "The Pressure-Production Relationship in the East Texas field," Drilling and Production Practice, 140, American Petroleum Institute, New York (1938).
2. Paul D. Torrey, "Selective Exclusion of Fluid From Wells," Drilling and Production Practice, 205 (1939).
3. Sam S. Taylor, C. J. Wilhelm, and W. C. Holliman, "Typical Oil-Field Brine-Conditioning Systems—Preparing Brine for Subsurface Injection," U. S. Bur. Mines R. I. 3434, Jan. (1939).

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Synthetic Chemicals From Petroleum

(Continued from Page 120)

the processing of cellulose-acetate plastics, in the synthesis of rubber chemicals, and in the manufacture of rotogravure and intaglio inks.

Besides these major products, scores of others are in various stages of development in the research laboratories and pilot plants of Shell Development Co. at Emeryville. Many of these are produced on semicommercial scale; among them are several unsaturated chlorides and alcohols and their derivatives made from propylene and the butylenes via substitutive chlorination,[5] followed by hydrolysis, chlorhydrination, etc.[1 6] A number of these products, with physical properties, are listed in Table 2. The first comercially practical synthesis of glycol[7] was an outgrowth of these developments. This is now ready for full-scale application whenever economic conditions justify.

Also in the stage of semicommercial development is butadiene, which is of growing interest in connection with the manufacture of synthetic rubber. Both Shell Chemical and Shell Development companies have been active in this development for a number of years, and have for some time been supplying from the small-scale plant at Emeryville, Calif., several tons a week of butadiene to rubber manufacturers.

These are only illustrations of the possibilities of chemical products from petroleum; among the many developments not touched upon is the wide variety of products from ethylene, such as ethyl alcohol, glycol and glycol ethers, and derivatives of acetylene, whose production from methane and other hydrocarbon gases has been shown to be feasible.

In the manufacture of chemicals from cracked petroleum gases the pioneers in the industry had attempted to react fairly complex mixtures of the various olefinic starting materials. This resulted in a multiplicity of main and side reaction products, with attendant difficulties of separation and purification. An important advance in manufacturing technique has been the separation of the mixture of hydrocarbons before reaction into small groups, such as C_3 (propane and propylene) or C_4 (butane and the butylenes), and the rigorous exclusion of harmful impurities such as sulfur compounds.

Not only have yields been improved by this means, but the resulting products themselves are produced eventually in high purity and of the unquestionable uniformity which is necessary for their application in many industries. For example, acetone used in the manufacture of artificial silk must be free from even the minutest amounts of active sulfur compounds, i.e., such as would corrode the metal spinnerets, whose constancy of diameter controls the denier of the silk fiber. When we first proposed to make acetone from petroleum gases, the head of a leading artificial-silk company stated that it would be impossible to think of meeting his requirements in this particular direction. In solving this problem the research laboratory first had to devise analytical methods applicable in the range of interest, i.e., of the order of 1 to 5 parts of sulfur in 10 million parts of acetone. The technique of such measurements was so perfected that we now are able not only to measure a total sulfur impurity of less than 5 parts in 10 million, but also to say within a 10 per cent error how much of that impurity is due to the presence of free sulfur, hydrogen sulfide, mercaptan, or other form of active sulfur.

By rigorous control of processing—including the purity of raw materials—guided throughout by such precise analytical procedures, acetone

Halliburton Oil Well Cementing Company president Erle P. Halliburton and vice president Claude P. Parsons plan a Lockheed flight.

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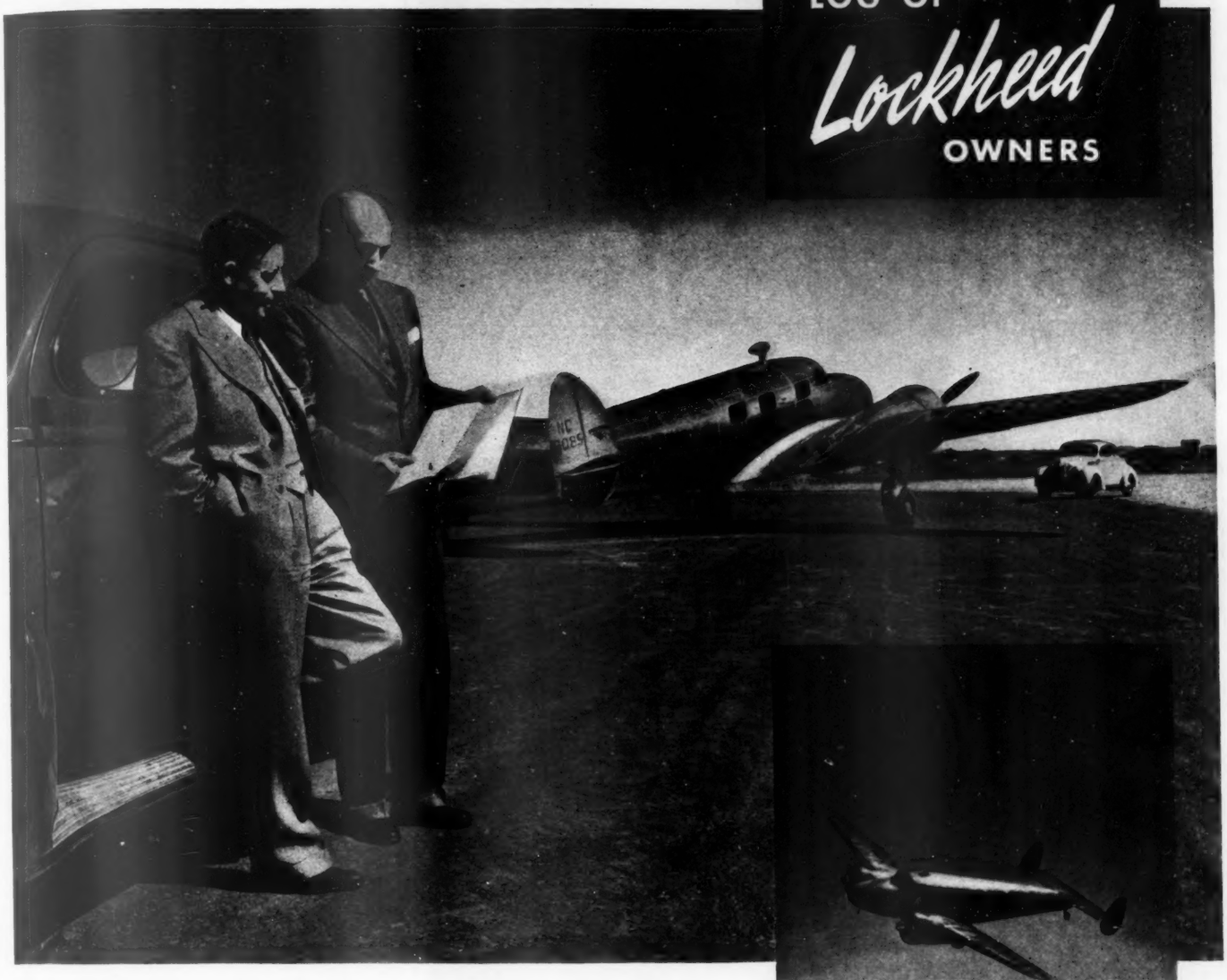

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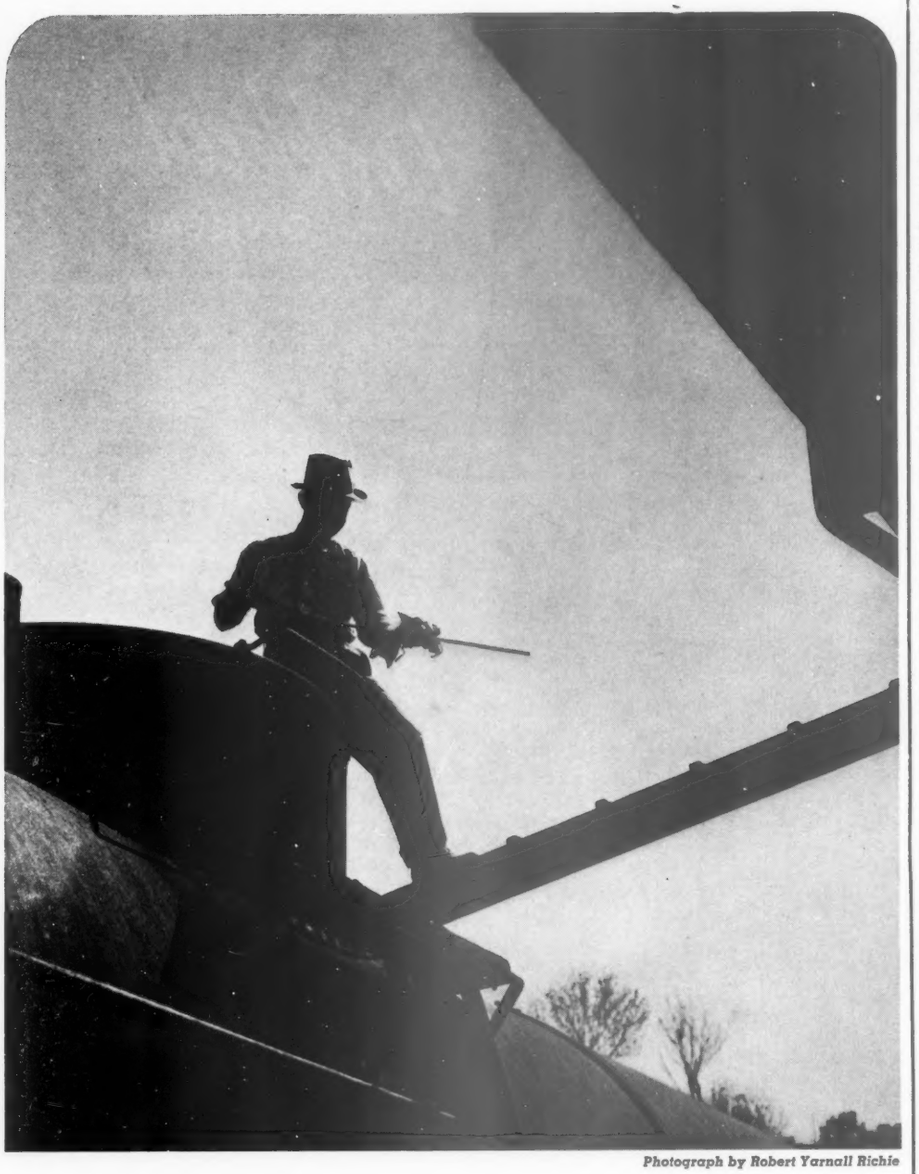

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and other chemicals are produced regularly in a high state of purity. In fact, the high level of scientific standards and scientific control of manufacturing operations, which has been necessary in the petroleum chemical industry, has reflected to the benefit of the oil industry as a whole.

Moreover, important changes have been brought about in the fundamental economics of the oil industry, as a result of its entrance into the field of synthetic chemicals. Thus the guiding principal of Shell Chemical Co.'s first operations was to utilize refinery gases that otherwise would go to waste or, at most, be consumed as fuel. It would have been difficult to foresee the revolution in gasoline manufacture which was to come about as a result of one of the steps in secondary-butyl-alcohol synthesis—the step which consisted in removal of the isobutylene content of the feed by absorption in cold sulfuric acid, and recovery of the acid by heating, which polymerized the isobutylene to diisobutylene, the source of iso-octane.

With the recognition of the possibilities of iso-octane in aviation fuel came the development of the process as a refinery operation; and it soon became a question not of finding outlets for waste products, but of supplying enough raw materials for the needs in both chemical and synthetic-gasoline fields. This has led to the development, on the one hand, of the hot-acid polymerization process and the alkylation process, which utilize a greater proportion of the available hydrocarbon feeds; and, on the other hand, of processes for increasing the supplies of the key hydrocarbons.

Although prediction of future trends in the oil industry must be hazardous, there is no question but that chemical manufacture will play an increasingly important role. In some instances there actually may be a reversal of the original position, i.e., the refinery may be utilizing by-products of the chemical factory, and not the factory the byproducts of the refinery. In any case, a close relationship may be expected as the operations of both expand into new fields.

Bibliography

1. E. C. Williams, Chem. Industries 44, 495-501 (1939).
2. R. E. Wilson, Chemistry & Industry, 1,095-1,101 (1939).
3. B. T. Brooks, Ind. Eng. Chem. 31, 515-9 (1939).
4. G. Egloff, J. Inst. Petroleum Tech. 23, 645-68 (1937).
5. J. Burgin, W. Engs, H. Groll, G. Hearne, F. F. Rust, and W. E. Vaughan, Ind. Eng. Chem. 31, 1,239-44; 1,413-19; 1,530-37 (1939).
6. G. Hearne et al, "Derivatives of Allylic Chlorides," to be published in Ind. Eng. Chem.
7. E. C. Williams, Ind. Eng. Chem. News Ed. 16, 630-32 (1938).

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Wyoming Government Lands Yield Large Revenues

Royalties, rentals, bonuses, etc., from the public domain in Wyoming, yielded the federal Government approximately $1,734,100 in the fiscal year ended June 30, 1940, of which the state will receive a check shortly from the United States treasurer for $650,288.77, according to notification received by Charles B. Morgan, deputy state treasurer. The figures, compared with 1939, 1938 and 1937, show a slightly upward trend in government revenues from the state. The accrued revenue from Wyoming in 1939 was $1,716,228; in 1938, $1,706,162, and in 1937, $1,601,671. The state received 37½ per cent of the last named amounts under the provision of the leasing act.

These totals are relatively small, however, as compared with revenues from the public domain in Wyoming in the days when Salt Creek, Grass Creek, Elk Basin and the other light-oil fields were at the height of their development. Royalties, rentals, etc., accruing to the Government from the public lands in Wyoming from 1912 to 1931, inclusive, aggregated $53,607,362. Development in most of these fields was just getting under way in 1912. Since 1931 the accrued royalties amounted to $1,300,000 to $1,700,000 a year.

The production on public lands in Wyoming in fiscal years of 1938 and 1939 was as follows:

	1938	1939
Petroleum (bbl.)	11,660,070	12,035,654
Gas (M.c.f.)	12,081,292	13,709,756
Gasoline (gal.)	25,754,114	24,228,520
Coal (short tons)	1,267,023	1,239,768

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Protection Against Static Electricity

By J. M. PEARSON
Sun Oil Co., Philadelphia, Pa.

THE phenomena that accompany the accumulation and release of static charges have been known to the human race and recorded since the time of the ancient Greeks. During the ages, our means for making experimental measurements and our coincident understanding have been promoted until the whole field of electrical knowledge belongs to the exact sciences. Basic principles now are established with extreme precision, and our theoretical tools are correspondingly reliable.

Mention of this is made here for the reason that, in the following, word pictures are going to be used instead of formulas. We are going to try to visualize what goes on, building the pictured from established elements and keeping the proportions in accord with measurement.

In our industry there has been in the past a significant amount of confusion, either in concept or terminology, between electrical ignition caused by arcs and that caused by sparks.

An arc occurs upon the interruption of a quite considerable current, and is the result of heat generated by the current at the point of interruption.

A spark occurs upon the initiation of a current flow, and results from a voltage that is high enough suddenly to break down the insulation in the spark gap. Arcs sometimes follow the path broken down by a spark.

In an explosive atmosphere arcs and sparks are equally villainous. In the experience of our industry dangerous arcs are almost unanimously the result of stray currents, whereas sparks arising from high voltages principally are due to accumulations of static electricity. We have definite effective means of dealing with each, but the respective methods are entirely different. To use an hydraulic analogy, if the average static current is represented by flow in a pipe half the size of a human hair, the average stray current would be represented by flow at the same velocity in a pipe line ¼ mile in diameter.

By the use of good conductors and by the application of straightforward engineering, we easily can cope with stray currents. Accordingly we shall turn our attention to questions of static electricity and remember that we are dealing with exceedingly small currents, harmless in themselves, until we permit them to produce an accumulating charge which suddenly might discharge in the form of a spark.

To build a clear picture we must begin with the following principles:

First: When any two different materials come in contact, there exists at the point of contact a "contact-potential difference." The contact boundary acts like a condenser with a positive charge on one plate and an equal negative charge on the other. The potential difference is of the order of a few hundredths of a volt, and the charges on opposite sides of each square inch of the boundary are in proportion to this voltage. The total charge separated, therefore, is proportional to the area of contact and to the contact-potential difference. Incidentally, the positive charge usually shows up on the material that has the higher dielectric constant.

Second: If the two materials are separated from contact, a very perceptible force is required to pull apart the separated positive and negative charges. As work is done against this force, two things happen: The voltage difference between the charges rapidly increases, and the charges begin to flow toward each other along whatever path is available. In one extreme, when one or both materials are good insulators, the charges are pulled apart mechanically so much faster than they can reunite by flow that the voltage increases from the original few hundredths of one volt to several thousand volts. In the other extreme, when semiconductors or good conductors are separated, the charges reunite very rapidly, and the phenomenon is represented by the flow of the small and harmless currents mentioned above.

A.P.I.—Presented before annual meeting, Chicago, Ill., November 11-15, 1940

We thus see that the crux of the static problem lies in preventing an accumulation of separated charges whose increasing voltage and final sudden discharge will lead to trouble. Let us take several typical examples from our industry, and follow the life history of the electric charges and deduce the best means of handling them.

Tank Truck

As the rubber tires on a truck roll over the pavement, about 70 sq. in. of each tire intimately are pressed against the pavement. The potential difference here is but a few hundredths of a volt. As the tire rolls, the separated charges are pulled apart, and the voltage on the tire tread not touching the pavement rises to between 2,000 and 15,000 volts. This terrific electrical pressure drives a very small current in toward the rim, and a charge begins to accumulate on the truck body. As the voltage of the truck rises, a current begins to flow through the rim of the low-voltage part of the tire tread that touches the pavement. As the truck voltage rises, the inflow of current is opposed and the outflow of current increases until equilibrium is established. Unhappily, by far the greater part of each tire is not touching the pavement, so the voltage on the truck is almost the same as that on the free portion of the tire treads.

Thus we gradually have accumulated a dangerous charge on the truck. The equal and opposite charge has been left in the ground and follows along under the truck as it moves over the ground, awaiting the first opportunity to reunite with the charge on the truck body. If, for example, the truck passes a low-hanging branch from a tree, the charges rush to meet each other and discharge with a crack when the air gap is short enough. If the truck end of this gap happens to be a vent emitting gas, a fire may be started.

This hazard greatly is reduced by the common use of drag chains. Even if the resistance from the truck to the ground through such a device is many millions of ohms, the chain (or other conductor) is ample to carry away the separated charges and to prevent their accumulation. A suggestion, presented here for future consideration, is that tire manufacturers be asked if they can make tires out of semiconducting rubber. Use of such tires would eliminate accumulation of static at the principal source.

Static may accumulate on a truck from other sources, such as dust or snow storms, or impinging steam. In each of these cases the other half of the separated charges is on the earth, so that the same means of equalization is effective.

Flow in Pipes and into Tanks

Saturated hydrocarbons are almost inactive by comparison with the electrical activity of some of the usual contaminants ("activity" referring here to production of contact-potential differences). Inasmuch as most storage tanks have water bottoms, their petroleum contents are contaminated with minute quantities of dissolved water. Other common contaminants are tetraethyl lead in gasoline, the presence of moisture and finely divided iron oxide picked up in pipe lines, and sometimes minute remnants of refinery treating solutions. Unsaturated hydrocarbons are thought to be more active than saturated hydrocarbons, but probably much less active than these contaminants.

In any event, experiments and measurements lead to this picture: Inside a pipe line for ordinary petroleum products there usually is a lining of hygroscopic metal oxide, some bare metal, moisture which adheres preferentially to the scale, and the petroleum product. During turbulent flow the more active elements of the stream rapidly are brought into contact with, and torn away from, the inner pipe wall. This results in a separation of charges between the volume of the stream and the pipe wall. As the potential of the volume charge rises, current is returned to the pipe wall by three means:

(*a*) By conduction (usually quite poor).

(*b*) By turbulence.

(*c*) By an actual mechanical pressure due to the attraction of the opposite charge on the pipe wall for the volume charge, and to the self-repulsion of the volume charge.

When the rate of discharge equals the rate of charge separation, the average charge per unit volume in the moving product becomes a fixed quantity. As long as the flow in a given pipe is turbulent, this charge per unit volume is independent of pumping speed. It comes to equilibrium at a value determined by the constitution of the stream, and by that of the pipe-wall surface. The maximum charge observed is of the order of one ten-millionth of a coulomb per gallon of product, with the result that the stream carries a current of the order of two-billionths of an ampere per gallon per minute. This varies down to currents one-twentieth as large. Professor McKeown's recent measurements on tank-truck gasoline-filling rates up to 800 g.p.m., and laboratory measurements at much lower rates in small pipe, agree on these values.

As the product arrives at its destination, which

(Continued on Page 203)

Fluid-Meter Research at University of Oklahoma

By W. H. CARSON and E. E. AMBROSIUS
Dean, College of Engineering — Associate Professor Mechanical Engineering
University of Oklahoma*

DURING the fall of 1931 several members of the American Society of Mechanical Engineers met in Tulsa to discuss research activities during 1932 of the Mid-Continent section of the society. A number of major problems confronting the mechanical engineers in the petroleum industry were considered. Because so little information was available covering the ramification of the metering of viscous fluids, it was decided to make this a major project.

In January 1932 the committee appointed to direct research was called together in Tulsa for a threefold purpose: first, to formulate test procedure; second, to consider the layout of physical equipment; and third, to discuss means of procuring, through donation, apparatus and materials for carrying on the work.

In April of the same year the committee met at the University of Oklahoma to make final plans for the fluid-meter tests. As the Southwestern Gas Measurement Short Course also was being held at the university at that time, it afforded the chief engineers of the various manufacturing concerns in attendance an opportunity to "sit in" on the committee meeting. It was decided to use commercial-size pipe and fittings throughout. Such arrangement would make it possible to move the test sections to the field for check tests under actual operating conditions. The layout of equipment, as approved, is shown in Figs. 1, 2, and 3, with a detailed explanation.

Theory of Fluid Flow

The same general physical laws govern the flow of fluid, whether it is gas, water, or oil. As the majority of meters used in the petroleum industry for the three services mentioned are either orifice, nozzle, or venturi meters (inferential type), it was decided to confine the first part of the research to these types of meters. Too, the committee reasoned, these meters could be used in any service, giving the advantage of the interchangeability of parts; also, there was already available a trained personnel to maintain and interpret chart information on these types of meters. It was supposed that, for a given size metering device, common coefficient curves could be used for all fluids, when the coefficients were plotted against the Reynolds number. The Reynolds number referred to is a dimensionless group of numbers, which has proved useful in analyzing the flow of fluids. From the group of numbers one can see in simplified form the ratio between the viscous and inertial properties of flow. Expressed mathematically, this ratio is:

$$R = \frac{Dvs}{u}$$

where

R = Reynolds number
D = diameter of pipe
v = velocity of fluid
s = density of fluid
u = absolute viscosity

The value of the Reynolds number increases as the viscosity decreases. For heavier crudes there is a low Reynolds number, and it increases as the change is made to lighter oils, water, steam, or gas. Theoretically, the coefficient curve would remain continuous throughout the entire range of fluids and Reynolds numbers. It was the hope of the committee that an orifice, a nozzle, or a venturi throat could be developed which would have a fairly flat coefficient curve over a wide range of Reynolds numbers. If this were accomplished, the inferential-type meter could be used in a practical way, in metering heavy viscous fluids as well as water and gas.

*The fluid-meter research carried out at the University of Oklahoma is being performed in cooperation with the special research committee on fluid meters of the American Society of Mechanical Engineers.

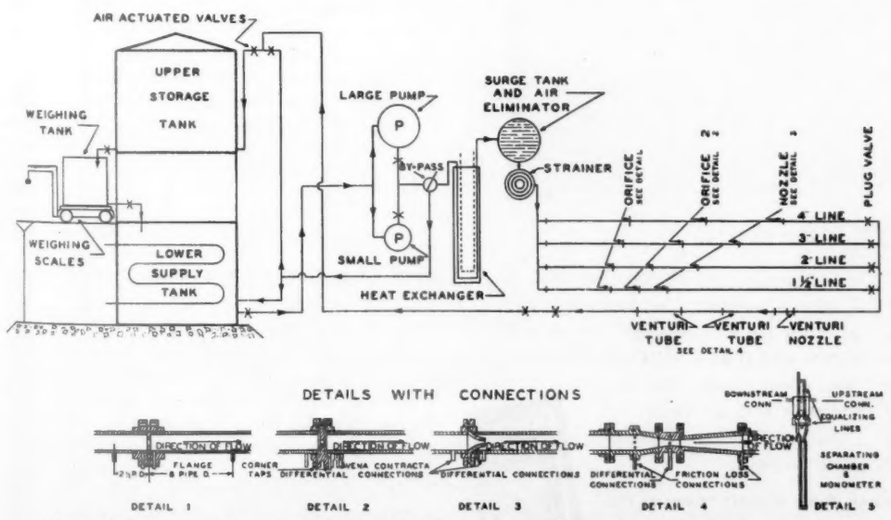

Fig. 1—Diagrammatic view—University of Oklahoma fluid-meter research on inferential-type meters

A. P. I.

The University of Oklahoma, School of Mechanical Engineering, in cooperation with the special research committee on fluid meters, of the American Society of Mechanical Engineers, for the past several years has been conducting research on meters for the measurement of oil.

The first tests were preformed on inferential-type meters such as orifices, nozzles, and venturi tubes on 1½-in., 2-in., 3-in., and 4-in. lines. Diameter ratios from 0.125 to 0.84 were employed, and the Reynolds numbers ranged from 50 to 80,000. This phase of the work was started in 1932 and is now complete. The data are in the hands of the committee, and a report is being prepared.

At present, attention is being directed toward the displacement type of meters, particularly those meters that are designed for the metering of oils. These meters range in size from 1½ in. to 6 in. Meter-accuracy tests are made at the University of Oklahoma, where special equipment is available. With this equipment it is possible to vary the flow rate through any meter from about 5 per cent to 125 per cent of its rated capacity, the maximum rate of flow being 450 gal. per minute. During the tests the medium-grade oil in the system was heated by suitable heat exchangers, thus varying its viscosity. Thus information is obtained on viscosity and temperature effects. To insure accuracy the meter readings were taken with the aid of a camera.

The results of the volumeter research show the general characteristics of the meters to be as follows: (a) Slip in sealing; (b) pressure-slip relationship; (c) mechanical and hydraulic friction; and (d) pressure drop resulting from fluid friction and in driving metering parts.

Paper was presented before Division of Production, at the annual meeting of the American Petroleum Institute, Chicago, November 11-15,

Calibration and Coefficient Tests

The first preliminary runs on the apparatus were made in December 1933, with Civil Works Administration assistants—using water as a circulating fluid in order to check existing coefficients, and thus certifying the apparatus—and were completed in April 1934. After that time, work was carried on by student assistants; but as they were limited both in number and allowable working hours, test work was intermittent

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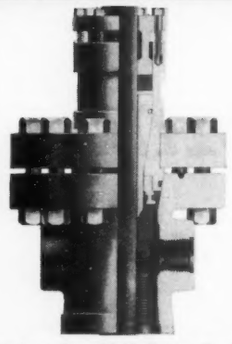

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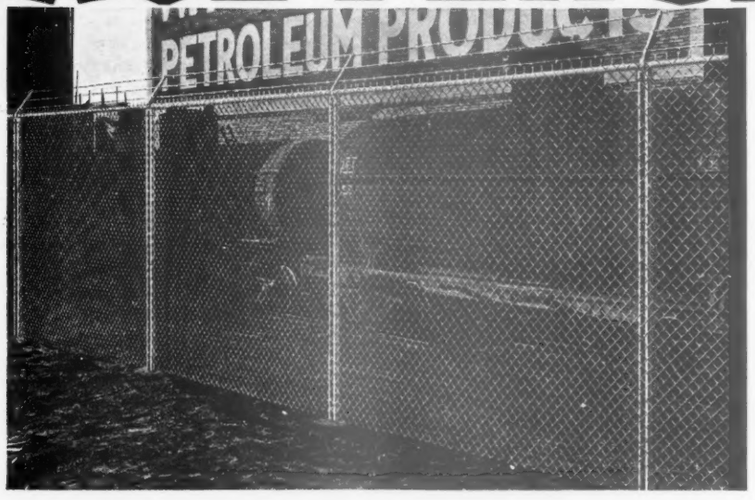

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and data accumulated less rapidly than in the preliminary tests.

In September 1935 this project was absorbed by the main fluid-meters committee of the American Society of Mechanical Engineers. In November of the same year test work was resumed by a Works Progress Administration crew, and has progressed rapidly up to the present time. The fluid used in these tests consisted of a blend of very viscous lubricating stock and gas oil produced by the University of Oklahoma refinery. With a temperature range of 50° to 220° F., Saybolt viscosities of 3,400 seconds to 58 seconds could be obtained. A calibration of the fluid viscosity and density was made throughout the entire range of operating temperatures. The viscosity determination was made with a Saybolt viscosimeter fitted with Saybolt Furol and Saybolt Universal capillary tubes, and the density determinations were made with a Westfall balance. These calibrations were made periodically for the purpose of checking the properties of the fluid. Fluid samples were sent to the National Bureau of Standards to be checked, thus insuring the correctness of our own tables and charts of the fluid properties.

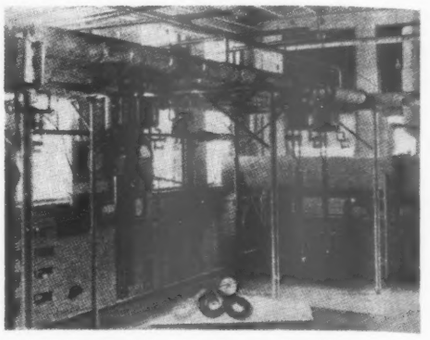

Fig. 2—General view of inferential-meter test setup. Heat exchanger in background

Petroleum Fluid-Metering Conference

By December 1937 sufficient information had been collected to justify calling together a group of men from the industry to discuss the findings, and to correlate results of the tests with those of experimental meter settings from various oil fields of the country. A program was organized, and the first Petroleum Fluid-Metering Conference was held at the University of Oklahoma on April 7 and 8, 1938. The 200 men or more who attended the meeting represented meter manufacturers, all branches of the petroleum industry, and a number of men connected with the regulatory bodies of the various state commissions. Pertinent questions on the metering of viscous fluids, air elimination, etc., were discussed. Most of the papers which were presented at the meeting concerned the use of inferential-type meters, and covered a general summary of the fluid-meter research at the University of Oklahoma, and the test results of many experimental meter installations in the petroleum industry.

Utility of the Orifice Meter

In commercial application of an orifice meter, when measuring viscous fluids, it has been found that the limits of accuracy are approximately plus or minus 2 per cent. However, it is so sensitive to unfavorable operating conditions that greater errors are not uncommon. In this connection it was agreed that an orifice should not be used in any case in which the Reynolds number is less than 10,000. This point reveals the principal objection to using the orifice meter for metering viscous fluids, which is that the coeffi-

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cient varies over a wide range, making it difficult to compute the quantity of oil flowing when there is a variable rate of flow. This is especially true if the orifice is operated at the lower values of the Reynolds number. This wide variation in coefficients can be seen from the curve in Fig. 4.

The correct flow can be approximated rather closely by the trial-and-error method in this region; however, this practice usually is frowned upon by the busy executive, because it consumes a lot of mathematical manipulation and time. The orifice is especially adaptable to water, steam, air, and gas, because the coefficient is practically constant over a wide range of flow rates. The water, steam, air, and gas regions are indicated on the coefficient Reynolds number curve, Fig. 4.

During the conference it was brought out that, when dealing with oils, this meter has the advantage in that it is useful in maintaining flow

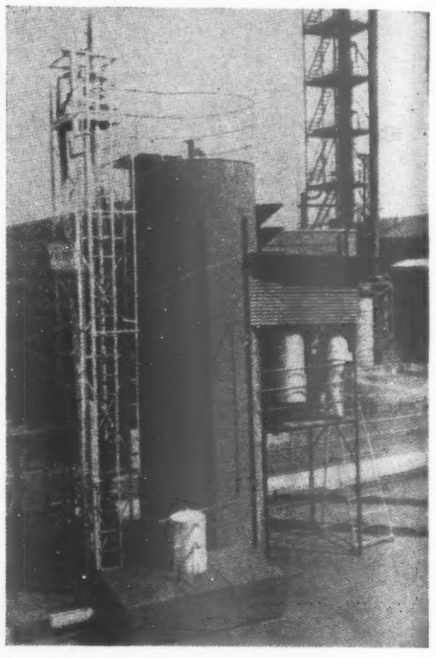

Fig. 3—Two-chambered tank with weighing tank and scales in position. Air-actuated flow valves are at top of tower at the left

rates, as an indicator in pipe-line work, to determine whether the pumps are functioning properly, to check approximate rate of flow, and to disclose excess leakage in the pipe line. The metering service recommended for the orifice, nozzle, or venturi is the measurement of viscous fluids when the flow is reasonably steady, at practically any desired pressure and temperature. These meters are used more commonly for measuring clean fluids; but by using suitable seals in the connecting piping, fluids carrying extraneous materials can be measured. These meters are sensitive to conditions of installation, swirling, pulsating flows, and surging. Sand in the oil soon removes the sharp edge in the case of the orifice, and thus changes the coefficient of the meter. Tests have proved that, if the edge is rounded, the indicated measurements will be low; therefore, care should be exercised to see that no sludge nor sediment has accumulated on the upstream side of the plate. Pressure taps and all connecting lines should be inspected often and cleaned out if necessary. Some operators have found it advantageous to use an enlarged section of the pipe before and after an orifice fitting. This may be explained by the fact that, if the fluid to be

measured is flowing through a 3-in. line, it would be necessary to install a section of 4-in. pipe, or larger, in order to get a satisfactory ratio between orifice diameter and pipe diameter. One major refining company reports that the cost of installing these enlarged sections for orifice meters on one of its units amounted to approximately $5,000. The company explained that such an expense was justified, because the capacity of the individual meter is increased, thus reducing the number of meters required.

The Petroleum Fluid-Metering Conference gave the manufacturers an insight into the metering problems confronting the operating companies. These men, as well as those engaged in fluid-metering research, left confident that meters, properly designed and installed with necessary auxiliary equipment, can be used for many services in the petroleum industry.

It was recommended that, after certain special tests had been completed on orifices at the University of Oklahoma, the test equipment should be rearranged so that exacting tests could be made on all types of displacement meters, commonly referred to as volumeters.

Volumeter Tests

The recommended special tests on orifices were completed, and by May 1939 the equipment had been rearranged, and tests were started on volumeters. Manufacturers contributed 22 meters for use in the first series of tests; these meters are for use in 2-in., 3-in., and 6-in. lines. The test equipment has been selected so that it will be possible to vary the flow through any meter from 5 per cent to 125 per cent of its rated capacity. The maximum rate at which tests can be made is about 450 gal. per minute. A diagrammatic sketch of the equipment layout for these tests is shown in Figs. 5 and 6.

The main A.S.M.E. fluid-meters committee made the following recommendation in regard to these tests:

A. Types of meters to be studied:

1. Piston types—(*a*) Cylinder and piston in duples and swash plate; (*b*) square piston; (*c*) bellows.

2. Rotary—(*a*) Sliding and swinging vane; (*b*) oscillating ring; (*c*) nutating disk; (*d*) West gas meter; (*e*) lobed impeller.

3. Inferential—(*a*) Turbine meter.

4. Weight meter.

B. Factors to be studied:

1. Nature of errors in volumeters—(*a*) Slip in sealing; (*b*) pressure-slip relationship; (*c*) mechanical and hydraulic friction; (*d*) recording mechanism load—variation of this load due to wear and corrosion of mechanism; (*e*) pressure drop required to drive; (*f*) distortion of case due to internal pressure; (*g*) displacement as a reference value; (*h*) variation between meters of same make and size, and between different sizes of same make.

2. Effects of associated conditions—(*a*) Uniform fluids—elimination of foreign liquids or gases; (*b*) elimination of solids; (*c*) effect of meter pulsations; (*d*) effect of line pulsations; (*e*) materials and design for strength and durability; (*f*) arrangement of piping before and after a meter.

C. Working information and materials:

1. Theoretical material to guide testing—(*a*) Slip formulation; (*b*) bearing, packing, liquid shear, and register friction; (*c*) relation between displacement line and calibration line, and effect on apparent corrections.

2. Test equipment factors to be considered—(*a*) Size relative to capacity of meter: (1) Measuring device large enough to handle maximum

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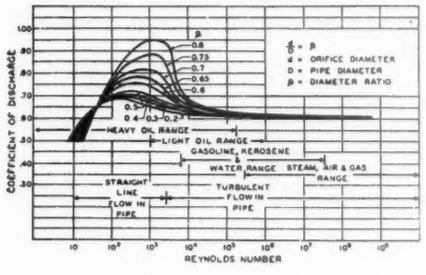
flow rate of meter over significant period of time; (*b*) precision: (1) For liquids, measuring device should be within a stipulated and reasonable per cent; (2) means provided for controlling, within close limits, temperature and pressure; (*c*) elimination of gas effects for liquid meters: (1) Adequate separation before metering; (2) liberation of absorbed gas in passing through meters; (3) evaporation of light ends after metering; (*d*) humidity corrections; (*e*) temperature and pressure corrections.

D. Test program:

1. For accuracy—At least two sizes of each type (or make). Tests at about 10 or more flow rates with three or more viscosities for liquids: air and gas (natural) for gas meters.

2. Durability—Eight to ten months on continuous full-flow operations, with accuracy check tests at suitable intervals.

The first tests being run on the meters are calibration or proof tests, and a medium-heavy oil is used. This type of test commonly is referred to as "the proof of the meter." Inasmuch as these tests are conducted by varying the temperature, viscosity, and flow rate, it is possible to find the effect these factors have on the accuracy of the meter when several different kinds of oil are used.



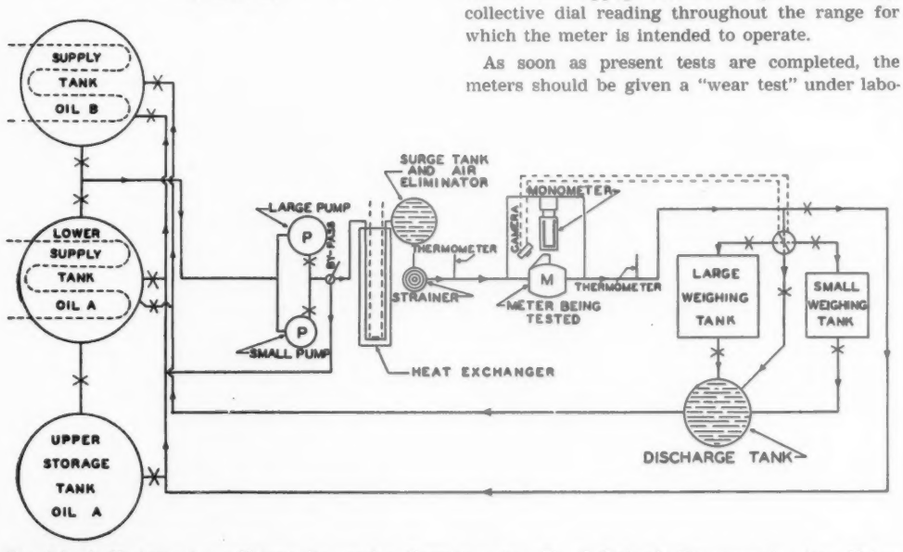


Fig. 4 (top)—Variation in coefficients for varying diameter ratios. Fig. 5 (bottom)—Diagrammatic view—University of Oklahoma fluid-meter research on volumeters

Factors Affecting "Slip"

There are factors which cause a resistance to the movement of the parts of any meter, viz.: fluid friction, friction of the metering element, and the registering index. As friction does exist, there will be a difference in pressure between the inlet and outlet side of the meters. The pressure drop across the meter is recorded on a manometer, with connections six pipe diameters on either side of the meter. The difference in pressure will cause a certain amount of the oil to squeeze by the various working parts of the meter. The oil that goes through a meter in this manner is referred to as "slip." A detailed study was made of "slippage" under different viscosity and temperature conditions, while each meter was operated at various flow rates. The general characteristics of a meter best can be shown through the use of a graph, as in Fig. 7. It will be noticed that the rate of flow is plotted against the quantity of oil that actually passes through the meter. If the slippage of oil past the working parts did not occur, the rate of flow and quantity passing through the meter would be the same. Flow, under this condition, would be represented by the straight line referred to as "displacement according to register." As there is slip, the actual curve plotted from test data takes the shape shown. In general, the greater the rate of flow, the less the per cent of slip. The per cent slip at low rates of flow increases very rapidly in most meters, and is known to the meter men in the industry as the "region of slip." This is shown by the fact that the test curve takes an upward trend under low rate-of-flow conditions. To compensate for slippage, the meter manufacturers install a gear train, which is intended to take care of the slippage volume and give an average collective dial reading throughout the range for which the meter is intended to operate.

As soon as present tests are completed, the meters should be given a "wear test" under laboratory conditions. To date wear-test equipment has not been installed.

Classification of Meters

The two general classifications of displacement meters are: Pack-sealed; and film or capillary-sealed. Leather, composition, or metallic ring-packed pistons are used in the pack-sealed meters; whereas in the case of film-sealed meters, close-working clearances which are filled with the fluid being metered are relied upon for this seal. The mechanical makeup of pack-sealed meters naturally would cause them to have a greater pressure drop than the film-sealed type of meter because of added friction in the metering element.

Meters must pass rigid requirements if they are to be used in the various services of the petroleum industry. Some of these requirements are listed as follows:

1. The meter must measure accurately at all rates of flow. This should be done despite the fact that variations of pressure, specific gravity, and viscosity may exist. The meter should be of such design that it will not permit the deposit of foreign materials, if such deposits affect its accuracy.

2. The meter must be constructed in such a manner that it offers very little resistance to flow. Because pressure loss in pipe lines is an important factor, pressure loss should not be increased appreciably by placing meters that have high rates of absorption in the line, as this would add materially to the pumping cost. Also, if the meter has a high-pressure drop, there is a possibility of all absorbed gases in the oil being driven off, in which case the accuracy of measurement would be affected.

3. The meter must have long life. In many instances a meter is expected to handle sand and paraffin, a combination which leads to rapid wear. The meter, therefore, should be constructed of materials that are corrosive and abrasive resistant, or be constructed so that these factors will not affect its accuracy.

4. The meter method of measurement must be as economical, or better than, present tank-gaging practice.

1940 Petroleum Fluid-Metering Conference

A report on the volumeter research was given before the group attending the second Petroleum Fluid-Metering Conference, which was held at the University of Oklahoma on April 11 and 12, 1940. In addition to this report a number of outstanding papers were given by men of the industry, in which they related their experience in the use and application of volumeters in the field of production, pipe-line, and refinery work. It is our opinion that the proceedings of this conference present a clear picture of the present status of the use of meters in measuring the quantity of viscous fluid flowing through a pipe. A summary of these proceedings is given in the following paragraphs:

Production of Crude Oil

The accurate measurement of oil produced, whether it be by the conventional tank-gaging method or by the use of meters, is important because it is the basis of paying royalty. Meters offer a great many advantages in the measurement of the flow of oil from the well. This type of operation permits the elimination of a large amount of lease tankage, and prevents evaporation loss, inasmuch as the crude oil can be handled under pressure in a closed pipe-line system. Another advantage is that lead lines from wells may be brought within close proximity of gasoline plants, where separators may be operated in a battery. This is especially true for unitized fields. Such an arrangement eliminates a pipe-line gathering system with its pumps, manifolds, piping, valves, etc.

Tank Gaging vs. Metering.

Some operators contend that tank gaging is more accurate than metering, whereas others have sufficient confidence in meters that they use them to calibrate their lease tanks. The perplexing question which naturally arises, therefore, is: how accurate might any new method be in comparison to tank gaging now in use? When a meter is used in connection with oil-production work, the oil should be prepared properly before it is metered. It is expecting too much from the meter, at the present stage of development, to produce very accurate results under exceedingly adverse operating conditions. The service to which a meter is subjected in production work is severe, at best; nevertheless, some of the strain of these conditions can be relieved by proper installation, and others must be overcome in the manufacture of the meter.

Dissolved gas and entrained gas are important factors to be considered in making any meter in-

stallation. The most up-to-date production practice in pools that yield high-gravity crudes is to stabilize the crude in the field, before it is delivered to the pipe line. By this method the light fractions, while under pressure, are removed in a stabilizer; thus a crude of predetermined vapor pressure may be produced. It has been estimated that as much as 50 per cent of the light ends lost by conventional gaging methods are saved by the stabilization practices made possible by the use of meters.

Pipe-Line Systems

The use of meters in the pipe-line industry has been receiving more and mose attention in recent years. Although this attention is steady and direct, the older systems are not being converted over to meters very rapidly. This seems to be a guard against rapid obsolescence of present equipment, and a desire on the part of company engineers and executives to wait until more information is available on the application of meters for this type of service.

In the construction of new systems, however, the major pipe-line companies consider it a general practice to install both displacement and orifice meters in the lines. When this is practice, the orifice is installed on the discharge lines from the pumping station, and the displacement meter is installed on the low-pressure side. The displacement meter has proved valuable in checking field streams at reception points; and, as stated before, the orifice is used to check pump performance and leakage in the pipe line. It becomes apparent that, if the producers are to use meters, the pipe-line companies must do likewise if the savings in light ends, lost by conventional gaging methods, are to be passed on to the refiner.

Refinery

The displacement meter's application to the measurement of petroleum and its products in refining methods is at the present time not as well adapted as one might suppose.

First of all, the degree of accuracy for most refinery processes does not have to be 99.9 per cent, as is encountered in the sale of the finished product. Accuracy in the order of magnitude of 1 per cent is sufficient. The chief objection, for the most part, to the displacement meter is that it does not indicate rates of flow. When crude oil is being charged to the still, it is essential that a constant rate of charging strictly be adhered to. This limits the displacement meter in favor of the orifice meter at the precent time.

Conclusion

The general consensus on the measurement of petroleum and its products through the use of meters and a closed pipe-line system is that:

1. Under normal conditions of measurement and installation, the meter has an economic advantage over the conventional tank-gaging method.

2. The change from one method of operation to another generally requires considerable time; often a company must use older and less efficient equipment until it has reached such a degree of obsolescence that it is economically feasible to replace it with something better—which is true in the adoption of oil meters.

3. The development engineers of the various oil-meter-manufacturing companies are to be commended for their fine work in developing the present-day meters; however, there is still need for improvement in the mechanical characteristics and wearing qualities of the meters, to make them adaptable over a wide and more varied range of operating conditions.

4. There must be an improvement of auxiliary equipment.

5. The greatest need at present is expansion of the fluid-meter research facilities at the University of Oklahoma, and the wholehearted support of the industry so this work can be carried on without interruption.

6. The Petroleum Fluid-Metering Conference

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Appendix

Description of Apparatus for Inferential Meters (See Fig. 1).

The tank referred to as "volume tank," and shown at the extreme left of Fig. 1, was made in two parts, an upper and lower section, each having a capacity of approximately 90 bbl. of fluid. It was considered that this would be sufficient volume to allow a complete run, even at the highest rate of flow, and it would not be necessary to weigh the oil during the test period. Normally the oil is stored in the lower section of the tank, the upper section being reserved to store the oil passed through the metering device. The weighing tank was located on an elevated platform, midway between the upper and lower tank sections.

The lower section was fitted with steam coils to heat the oil and decrease the viscosity to such an extent that the oil could be handled by the pumps. A steam jacket was welded around the suction line to the pumps to provide heat for warming the oil. Two gear pumps, used singularly or in parallel, pumped the oil from a common intake manifold to a heat exchanger and into the line. There was a plug valve in the bypass line to connect the discharge manifold to the lower tank, and it could be adjusted to recirculate any portion of the fluid, thereby regulating the rate of flow through the test apparatus. The viscosity of the oil was changed by varying its temperature. This change of temperature was accomplished in the heat exchanger, through which the oil flowed on its way to the test line. It was possible also to circulate either tap or refrigerated water through the heat exchanger.

During the summer months it was necessary to cool the oil, in order to maintain constant conditions throughout the test. The temperature was maintained accurately by a Tycos direct-set temperature control of the steam valve on the heat exchanger. By lagging the line, the temperature

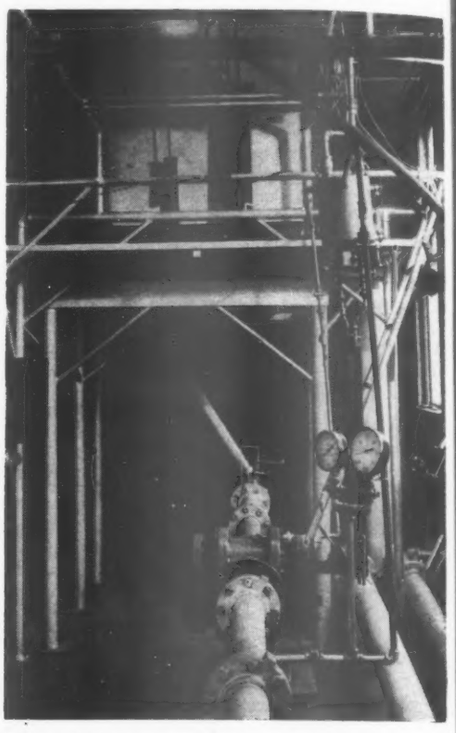


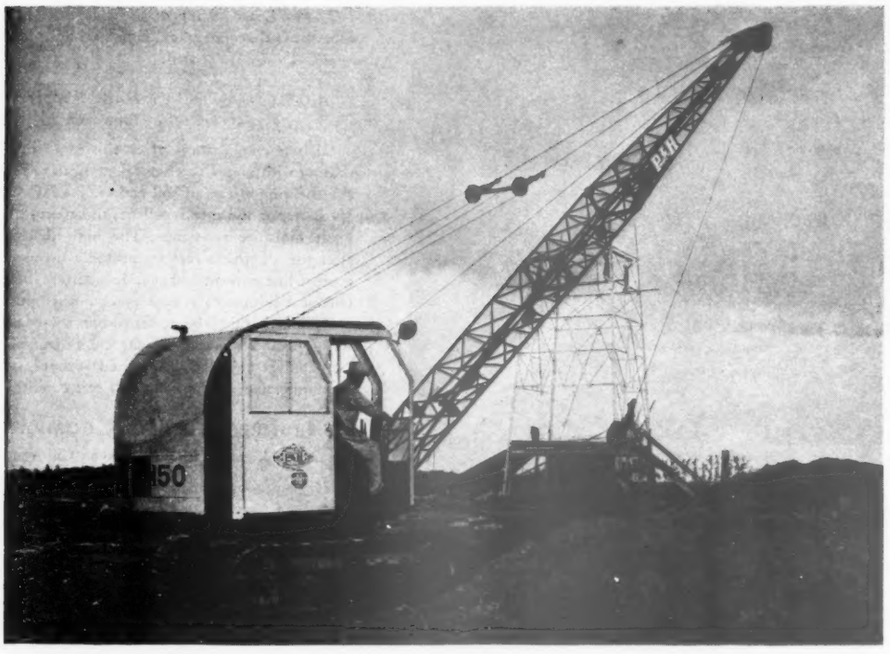
Fig. 6—Volumeter in position for test. Note camera at right

drop over the test line was kept below ½° F., except for extremely high temperatures and low rates of flow. A Brown recording potentiometer gave an indication of the inlet and exit temperatures. The potentiometer-recorded temperatures were checked with thermometers in wells, at the inlet and outlet of the test line.

The test lines were geometrically similar in every respect, and consisted of 1½, 2, 3, and 4-in. pipe; on each there were two orifice fittings and one nozzle fitting. All lines were discharged into a 4-in. return line, in which was installed a venturi tube and venturi nozzle. Plug valves were installed in each of the test lines so that flow could be shut off from all lines except the one under test. The 4-in. return line was connected to the manifold at the top of the volume tank, where two air-actuated valves were located. These valves were so arranged that the flow of oil could be diverted to either the upper or lower tank section. By having the valves installed at the top of the tank, the back pressure on the test line was the same, regardless of the tank into which the fluid was discharged. Flow conditions were not disturbed by the transfer of oil from one tank to another.

The orifice fitting No. 1, as shown in detail 1, was arranged so that differential-pressure readings could be taken at the flange connection and at connections 2½ pipe diameters upstream and 8 pipe diameters downstream. At orifice fitting No. 2, shown in detail 2, differential-pressure readings were taken at corner taps annularly arranged in the flanges with annular pressure connections about $\frac{1}{16}$-in. wide. There was also a connection one pipe diameter upstream with the downstream connection at the vena contracta, or point of lowest static pressure. This necessitated several connections in order to accommodate the various diameters of the orifice employed.

The flow nozzles were located in the line imme-



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diately following the orifice meters; however, when tests were conducted on the nozzles, the orifice meters were removed from the line, thus eliminating the possibility of any flow disturbance which might introduce errors in the discharge coefficients. The upstream pressure connections were located at a point one pipe diameter ahead of the nozzle, with the downstream connection either just inside the end of the nozzle or in the throat of the nozzle itself. The venturi nozzles and venturi tubes, located in the 4-in. return line, were

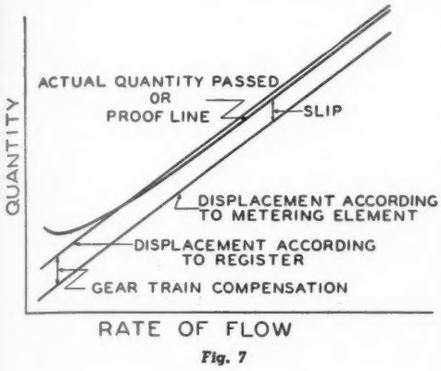

Fig. 7

fitted with loss as well as differential connections. Separating chambers and manometers were installed on all differential taps; a general arrangement of this assembly is shown in detail 5.

The differential pressures, except in a few cases were obtained from mercury manometers and inverted water manometers, with the aid of separating chambers containing water as a sealing liquid. This arrangement permitted differential pressures from about 1 in. of water to 30 in. of mercury.

Test Procedure for Inferential Meters.

In brief, the test procedure was as follows: The oil was drawn from the lower section of the volume tank, and pumped through the heat exchanger into the line in which the test meter was installed. The oil then returned through the 4-in. line to the manifold located at the top of the volume tank, and thence through the air-actuated valve back to the lower chamber. This circulation was continued until viscosity, rate of flow, pressure, and temperature became constant.

With all conditions constant, the oil was diverted through the manipulation of the air-actuated valves to the upper section of the volume tank. A stop watch was started the moment the oil was diverted, and the necessary data were taken during the run, which consisted primarily of reading manometers, thermometers, pressure gages, etc. At the end of the run the oil was rediverted to the lower tank and the stop watch was stopped, thereby giving the time elapsed during the test. The oil, which had flowed into the upper tank during the test period, carefully was weighed and dumped back into the lower storage tank.

No changes were made in the rate of flow of the oil which was still being recirculated through the lower tank during the weighing process, until the results of the test had been computed and plotted. If the test point in question did not fall on the curve, then a check test was made. A test crew of approximately six men was required to make the necessary observation of temperature and differential pressures. The men making the readings worked in a circuit, each man taking the same reading as rapidly as it could be noted on a data sheet bearing the observer's signature. The average of the data recorded by each man was compared with that of the group, and in this way an erratic or haphazard method of recording data by any member of the crew would become apparent.

Test Procedure Using Volumeters.

The method of controlling flow rates, temperatures, etc., is essentially the same as that described for tests on the inferential meters. There is one exception, however, and that is the matter of weighing the oil, which in this case is weighed on one of two scales—a large one having a capacity of about 800 gal., sensitive to ½ lb., and a smaller one having a capacity of about 200 gal., sensitive to 1/10 lb. (Fig. 5). The length of any test is determined by the time required to fill the large tank in the case of large meters, and the length of time required to fill the small tank for small meters. In using only one weight reading per test, greater accuracy is obtained, because the possibility of accumulative error is eliminated. The number of pounds of oil which has passed through the meter during any test is converted to a volume corresponding to the average temperature of the meter. This volume is determined with the aid of a density table for the oil in question.

Inasmuch as weights are converted into volumes, it is necessary to correct the test weight for the buoyant effect of the air; neglecting to make this correction would introduce an error greater than one-tenth of 1 per cent. Before a test is begun, the oil is circulated through a bypass until pressure, temperature and other conditions become constant, and the desired constant rate of flow is reached. To simplify the computation of results, the bypass valve is adjusted to give a flow rate of 10 gal. per unit of time, or some even multiple thereof.

To insure accuracy in obtaining the dial readings, a camera is used at the beginning and end of each test (Fig. 6). The camera shutter is actuated by an electric solenoid, which is caused to operate the instant the timekeeper diverts the oil into the weigh tank. With the use of these pictures it is possible to obtain meter index readings of 0.01 gal.

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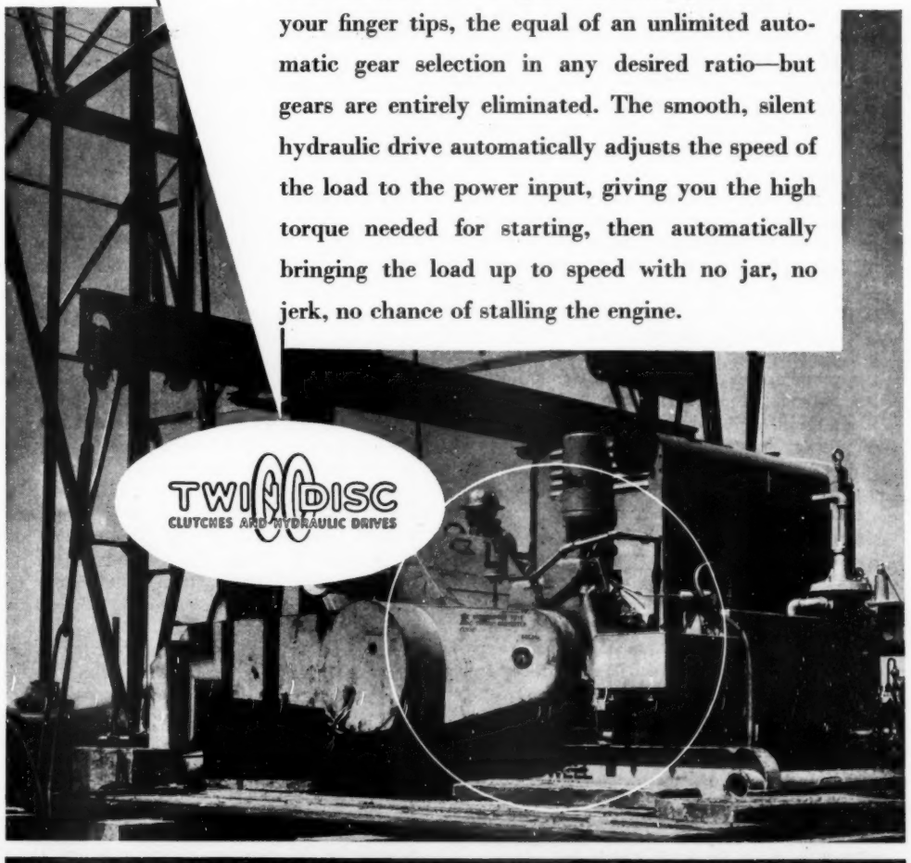

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Use of Azeotropic Distillation

In Separating Hydrocarbons From Petroleum

By FREDERICK D. ROSSINI,* BEVERIDGE J. MAIR,† and AUGUSTUS R. GLASGOW, JR.‡

A. P. I.

There is presented a brief discussion of azeotropic distillation, including the principles involved, the substances that form azeotropic mixtures with hydrocarbons, the separation of hydrocarbons by azeotropic distillation, the benefits of prior distillation at reduced pressure, the separations obtainable, and mention of some commercial applications.

Paper was presented before Division of Refining at the annual meeting of the American Petroleum Institute, Chicago, November 11-15, 1940.

WITHIN the past 10 years a chemical industry has been founded upon the use of petroleum as a raw material. The development of this petroleum chemical industry has been made possible through the separation in a relatively pure state of individual hydrocarbons from petroleum or from appropriate products of the refining process. There now are produced by such separations, in commercial or semicommercial quantities, a considerable number of pure hydrocarbons, including methane, ethane, propane, isobutane, normal butane, isopentane, normal pentane, neohexane, ethylene, and propylene, together with mixtures of isomers of the same class of hydrocarbons, such as the mixed hexanes, mixed heptanes, mixed octanes, mixed butenes, and aromatic concentrates of benzene, toluene, and "xylene."

In the separation of pure hydrocarbons in the laboratory, A.P.I. Research Propect 6 has used the fractionating processes of distillation, crystallization, extraction, and adsorption. These same tools are available to the refiner for separating hydrocarbons on a large scale. In previous reports of Research Project 6 mention has been made of distillation at different pressures, and also of distillation with an azeotrope-forming substance. Azeotropic distillation, although not commonly used by the refiner, is a powerful fractionating tool, and frequently can be used to separate hydrocarbons not separable by ordinary distillation.

For the purposes of this paper, azeotropic distillation may be described as follows: Assume a mixture of two hydrocarbons of different type, as a paraffin and an aromatic, which have the same boiling point. These two hydrocarbons cannot be separated by ordinary distillation at a given pressure. However, there may be added to this mixture a third substance, which has the property of changing by different amounts the boiling points of the two hydrocarbons in the mixture and so making them separable by distillation in the presence of this added substance. The first part of the distillate will be a constant-boiling azeotropic mixture of one hydrocarbon with the added substance, and the last part of the distillate will be another constant-boiling azeotropic mixture of the second hydrocarbon with the added substance. The process of distilling in the presence of such an added azeotrope-forming substance constitutes azeotropic distillation. The added substance subsequently is removed from the azeotropic distillate in an appropriate manner. The sharpness obtainable in the separation of two hydrocarbons by such azeotropic distillation depends in general upon the efficiency of the still and upon the difference in the boiling points of the azeotropic mixtures produced.

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The purpose of this paper is to present a brief discussion of azeotropic distillation, and to indicate how this little-used fractionating tool may be applicable to some of the problems of the refiner.

Principles Involved in Azeotropic Distillation

In the ideal liquid solution the partial vapor pressure of each component is directly proportional to its mol fraction and the total vapor pressure is the sum of the partial vapor pressures of the several components. The laws of the ideal solution imply that the interaction between unlike molecules is the same as that between like molecules.

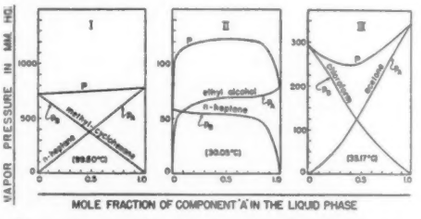
In many real solutions it is found that the ideal-solution laws are obeyed. One such example is the solution of normal heptane and methylcyclohexane, the vapor pressures for which are illustrated in Part I of Fig. 1.

Deviations from the laws of the ideal solution will occur when the interaction between unlike molecules is significantly different from that between like molecules. Such deviations may be manifested by partial vapor pressures either greater than or less than the ideal values for the given concentrations of components. Part II of Fig. 1 gives the partial and total vapor pressures for the solution of normal heptane and ethyl alcohol, which yields a mixture having a total vapor pressure greater than that of the more volatile pure component, ethyl alcohol, and there results a minimum-boiling azeotropic mixture. Part III of Fig. 1 gives similar data for the solution of acetone and chloroform, which yields a mixture having a total vapor pressure less than that of the less-volatile pure component, chloroform, and there results a maximum-boiling azeotropic mixture.

One characteristic feature of the temperature-composition diagrams for those systems forming azeotropic mixtures is that, except at the composition of the constant-boiling mixture, the difference in composition between the liquid and vapor phases is usually much greater than it is in systems that do not form azeotropic mixtures. This difference in the shapes of the liquid-vapor curves for the two kinds of solutions is illustrated in Fig. 2, which gives the temperature-composition diagrams for the system of benzene and *n*-hexane and for the system of benzene and ethyl alcohol. The much greater difference in composition (except for the constant-boiling mixture) between the liquid and vapor phases for the latter system than for the former is readily apparent. The separation of the azeotropic mixture of benzene and ethyl alcohol from either pure benzene or pure ethyl alcohol may be accomplished with distillation apparatus of relatively small separating efficiency.

Azeotropic Mixtures With Hydrocarbons

With some exceptions, nearly all polar organic molecules of the proper volatility form with hydrocarbons of the paraffin, naphthene, aromatic, and olefinic classes mixtures that have a total vapor pressure greater than that of the more-volatile pure component, yielding minimum-boiling azeotropic mixtures. The organic compounds that form azeotropic mixtures with these hydrocarbons include those containing hydroxyl, carboxyl, cyanide, amino, nitro, and other structural groups that tend to produce polarity in organic molecules. For a substantially complete list of the data that have been published on azeotropic mixtures having a hydrocarbon as one component, the reader is referred to the publications of Lecat.[5 9 10 11]



The scale of ordinates gives the vapor pressure in millimeters of mercury, and the scale of abscissae gives the mole fraction of the component that is the more volatile in the pure state. The data are from the following sources: 1, from Beatty and Calingaert,[2] and Willingham and Rossini[3]; 2, from Ferguson, Freed, and Morris[4]; 3, from Zawidsky.[1]

Fig. 1—Partial and total vapor pressures for the ideal and for eight real binary solutions

For the five binary minimum-boiling azeotropic mixtures formed between a given azeotrope-forming substance and a paraffin, naphthene, monoolefin, diolefin, and aromatic hydrocarbon, respectively, with the five hydrocarbons having about the same boiling point, the lowering of the boiling point will be greatest for the paraffin azeotrope and least for the aromatic azeotrope, with the others intermediate and generally in the order given.

For the binary azeotropic mixtures formed between a given azeotrope-forming substance and the members of a homologous series of hydrocarbons, both the boiling point and the composition of the azeotropic mixtures approach, with increase in the boiling point of the hydrocarbon, those of the pure azeotrope-forming substance, i.e., for example, the azeotropic mixture of ethyl alcohol and normal pentane will have a boiling point just below that of the pure hydrocarbon, and the composition will be low in alcohol and high in hydrocarbon; whereas the azeotropic mix-

ture of ethyl alcohol and normal octane will have a boiling point just below that of pure ethyl alcohol, and the composition will be low in hydrocarbon and high in alcohol. Conversely, for the binary azeotropic mixtures formed between a given hydrocarbon and the members of a homologous series of azeotrope-forming substances, both the boiling point and composition of the azeotropic mixtures approach, with increase in the boiling point of the azeotrope-forming substance, those of the pure hydrocarbon.

Separation of Hydrocarbons by Azeotropic Distillation

In the work of the A.P.I. Research Project 6 on the separation of hydrocarbons by azeotropic distillation, it is usually required of an azeotrope-forming substance that it:

1. Have a boiling point near (not more than about 30° or 40° C. away from) the boiling range of the hydrocarbons to be separated;

2. Be completely soluble in water and preferentially less soluble in the hydrocarbon at room temperature, in order that the removal of the azeotrope-forming substance from the hydrocarbon with which it is associated in the azeotropic distillate may be accomplished easily by extraction with water;

3. Be completely soluble in the hydrocarbon at the distillation temperature, and for some degrees below this, in order that two phases shall not form in the condenser and reflux regulator and thus cause difficulty in the operation of the latter;

4. Be readily obtainable in a sufficiently pure state at reasonable cost; and

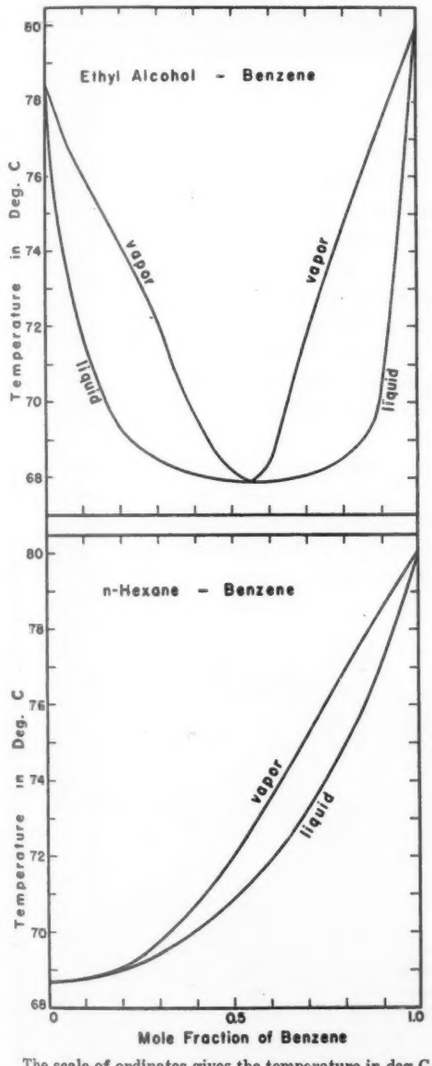
5. Be nonreactive with hydrocarbons or with the material of the still.

For operation on a large scale, the above criteria would require some modification. For example, in order to reduce the cost of processing, the azeotropic distillate should be rich in hydrocarbon and lean in the added substance. This calls for an azeotrope-forming substance with a boiling point higher than that of the hydrocarbons to be separated. The modification probably would be accompanied by a decrease in the degree of separation obtainable with a given still. Likewise, operation on a large scale would require the actual recovery and recirculation of the azeotrope-forming material.

The azeotrope-forming substances that have been used successfully in this laboratory in separating hydrocarbons according to type include the following compounds, which alone boil approximately at the temperatures given:

Compound—	Boiling point at 1 atmosphere (°C.)
Methyl alcohol	66
Ethyl alcohol	78
Methyl cyanide	82
Acetic acid	118
Ethylene glycol monomethyl ether acetate	143
Ethylene glycol monobutyl ether	171
Diethylene glycol monomethyl ether	193

In preparing for the separation of the hydrocarbons occurring in any given fraction of petroleum, it is necessary to have the mixture of hydrocarbons well separated by a systematic and efficient distillation into a series of substantially constant-boiling fractions, prior to the azeotropic distillation. This is necessary in order to avoid having any paraffins mixed with lower-boiling naphthenes and, in turn, any paraffins and naphthenes mixed with lower-boiling aromatics, which kind of mixing will tend to nullify the separation normally attainable by the azeotropic distillation of mixtures of hydrocarbons of the same boiling point.



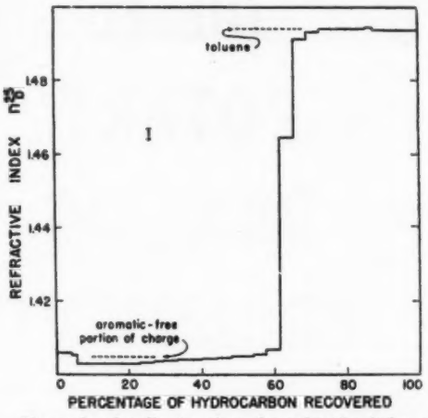
The scale of ordinates gives the temperature in deg C, and the scale of abscissae gives the mole fraction of benzene. The diagram for the system of ethyl alcohol and benzene is constructed from the data of Fritzweiler and Dietrich,[4] whereas that for the system of *n*hexane and benzene is constructed from the data of Tongberg and Johnston.[5]

Fig. 2—Diagrams of temperature vs. composition for both the liquid and vapor phases for the binary solutions of ethyl alcohol and benzene and of n-hexane and benzene, at a pressure of 1 atm.

Benefits of Distillation at Reduced Pressure

By the same reasoning, any preliminary fractionation that will serve to displace paraffin hydrocarbons into mixtures with higher-boiling naphthenes, and, likewise, paraffin and naphthene hydrocarbons into mixtures with higher-boiling aromatic hydrocarbons, will enhance the separation over that attainable in the azeotropic distillation of hydrocarbons of the same boiling point. One process that will displace the various hydrocarbons in exactly the manner required for this enhancement of the separation is that of distillation at a pressure reduced below that of the normal distillation pressure. Distillation at reduced pressure serves to displace paraffin hydrocarbons into fractions with normally higher-boiling naphthenes. Likewise, distillation at reduced pressure displaces paraffin and naphthene hydrocarbons into fractions with normally higher-boiling aromatic hydrocarbons. This displacement is a result of the fact that the boiling points of the aromatic hydrocarbons decrease more rapidly with decreasing pressure than do those of the naphthenes and, likewise, those of the naphthenes decreases more rapidly with decreasing pressure than do those of the paraffins.

For example, as the pressure is reduced from 1 to 0.075 atm. for hydrocarbons of the gasoline and kerosene ranges, the boiling point of a given paraffin hydrocarbon may be lowered about 85° C.; whereas for a naphthene and an aromatic hydrocarbon of about the same boiling point at 1 atm. the lowering will be greater—about 2° C. more for the naphthene and about 5° C. for the aromatic.



The scale of ordinates gives the refractive index of the hydrocarbon recovered from the azeotropic distillate, and the scale of abscissae gives the percentage of the hydrocarbon recovered. The distillation was performed in a Bruun[3] glass bubble-cap column, of 138 rectifying units, equipped with a special pot, head, and jacket assembly,[3] with a reflux ratio of about 40 or 50 to 1, a rate of removal of distillate of about 20 to 25 ml per hour, and a total time of distillation of about 100 hours.

The plot shows the results of the azeotropic distillation, with methyl cyanide at atmospheric pressure, of a mixture of toluene (boiling point 110.6 deg C) with a narrow-boiling (110.0 to 110.5 deg C) mixture of paraffins and naphthenes. The azeotropic distillate was by volume about 20 per cent of hydrocarbon for the aromatic and about 25 per cent for the paraffins and naphthenes, with the latter forming a two-phase mixture with methyl cyanide at the distillation temperature.

Fig. 3—Diagram illustrating the separation of an aromatic hydrocarbon (toluene) from naphthenes and paraffins by azeotropic distillation

Separations Obtainable

The results obtained in separating aromatic hydrocarbons from naphthenes and paraffins by azeotropic distillation are illustrated in Fig. 3, the separation being indicated by the change in refractive index with the amount of hydrocarbon recovered. Fig. 3 shows the separation obtained in the azeotropic distillation, with methyl cyanide (boiling point 82° C.), of a mixture of toluene (boiling point 110.6° C.) with a substantially constant-boiling (110.0° to 110.5° C.) fraction of petroleum containing paraffin hydrocarbons with some naphthenes. The separation of toluene from these paraffin and naphthene hydrocarbons having substantially the same boiling point is almost quantitative. The separation of toluene from the appropriate fraction of petroleum would be accomplished with even greater ease for the reason that, in ordinary distillation with a mixture of paraffin and naphthene hydrocarbons, toluene tends to be displaced into fractions containing lower-boiling paraffins and naphthenes, because the toluene in such a mixture possesses a partial vapor pressure in greater excess of the ideal value called for by its concentration than do the paraffin and naphthene hydrocarbons. Such a displacement, operating in a direction similar to the displacement produced by distillation at reduced pressure, enhances the separation obtainable in the azeotropic distillation.

As contrasted with the relatively easy separation of aromatic hydrocarbons from naphthenes and paraffins, the separation of naphthenes from paraffins is accomplished with greater difficulty.

(Continued on Page 219)

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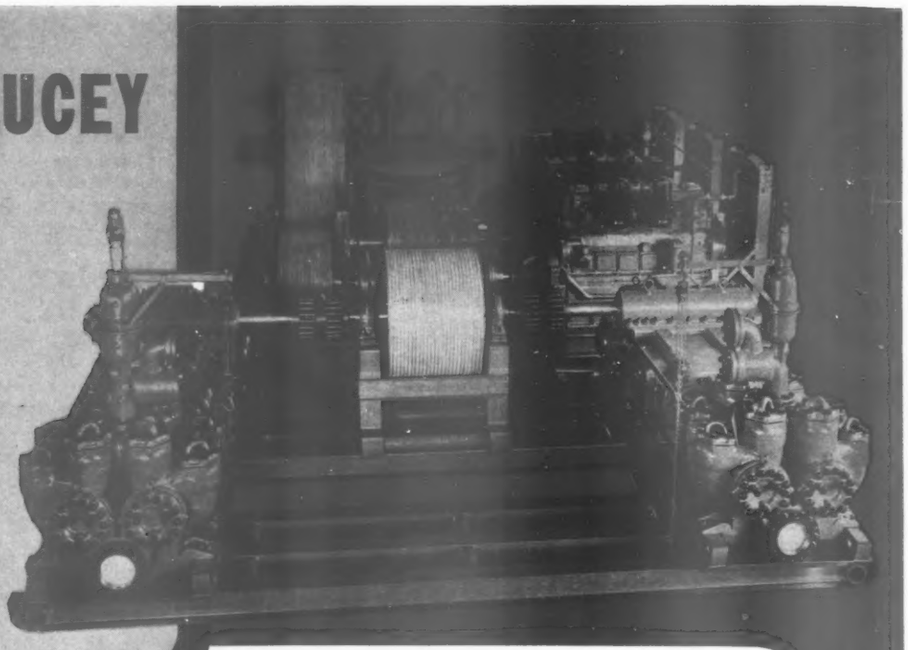

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Oil Recovery by Air Drive in Venango Fields of Pennsylvania

By PARKE A. DICKEY and ROBERT B. BOSSLER
Pennsylvania Topographic and Geologic Survey*
Brundred Oil Corp.

A. P. I.

The secondary recovery of oil by air drive for approximately 15 years has been practiced generally in the Venango oil fields of northwestern Pennsylvania. Hitherto no attempt has been made to analyze the results and estimate the quantity of oil recoverable by this method.

The production-decline curves of properties on which no new development has taken place over a period of several years approximate straight lines on logarithmic paper. Following accepted procedure, the economic life and cumulative ultimate oil recovery of the properties thus may be predicted. Unfortunately predictions could be made for only a few of the older properties and for none of the newer developments because, on most leases, new work so affected the oil production that no conclusions could be drawn. Twelve leases showed suitable curves. The estimates of cumulative ultimate recovery range from 11 bbl. to 100 bbl. per acre-foot, with an average of 42 bbl. The economic life ranges from 9 to 48 years, with an average of 28 years.

Whereas a large number of factors affects the recovery of oil by air drive, it is believed that the principal ones are the original oil and water content of the sand, the spacing of the wells, and the efficiency of the application of air to the sand. The latter factor seriously is affected by the bypassing of air through the more permeable beds, and is difficult to take into account.

It is suggested that ultimate oil recovery and well spacing are connected by an equation of the type:

$$y = ae^{-bx^P}$$

Tentative values, based on the available data, were assigned to the constants.

Paper was presented before Division of Production at the annual meeting of the American Petroleum Institute, Chicago, November 11-15, 1940.

SECONDARY-OIL recovery by the Smith-Dunn or air-injection process has been practiced in the Venango fields of Pennsylvania for more than 20 years. In most areas considerable increases in recovery have been obtained. Numerous papers discussing the method have been published, but no recent nor thorough-going studies have been made, and particularly no well-founded estimates of the ultimate possible recovery have been published. In this paper a brief discussion of the methods in common use in the Venango fields is given; and attempt is made to predict ultimate oil recoveries by means of decline curves; and the factors influencing recovery are pointed out. As the principal subject of the study is oil recovery, field practices and methods are not discussed at length. A recent publication[1] provides a very complete bibliography of secondary-oil-recovery methods and, therefore, no attempt is made to give references in this paper.

Location and Geology of Fields

The area under discussion usually is referred to as the Middle district, or Venango fields. It consists of a belt of productive pools underlying a large part of Venango County, and extending into Crawford, Warren, and Forest counties. It is the oldest field in the United States, and its flush production was passed before 1880.

The producing sands are found in a zone approximately 300 ft. thick, which is overlain and underlain by at least 250 ft. of shale. Table 1 shows the position of the sands in the geologic section.

The oil sands are lenticular bodies, usually irregular in shape, of widely different area, and elongated in a northeast-southwest direction. Detailed studies now in progress indicate that the sands probably were deposited near and parallel to an old shore line.

The sands are principally white quartz sandstones, often very pebbly, and containing numerous thin beds of shale and sandy shale. The sand grains are commonly overgrown and cemented with secondary silica. Calcite is common in the interstices. The porosities range from 10 to 25 per cent, and permeabilities from 0 to 2,000 millidarcys. The permeability varies notably in a vertical direction and to a lesser extent horizontally, which makes the efficient application of air drive difficult.

Structurally the oil fields lie in the northwestern part of the Pittsburgh-Huntington synclinorium. The beds dip 20 ft. and 25 ft. to the mile to the south in a rather uniform manner. Minor structural features, which may be described as gentle wrinkles or terraces on the south-dipping surface, seldom afford closure. Structure has very little effect on the accumulation, and productive fields occur on and off the wrinkles.

Descriptions of the geology of the Venango fields may be found in the reports of the Second Geological Survey of Pennsylvania.[2] A detailed survey is now in progress, and an advance report on one quadrangle has been published.[3]

The localization of the pools appears to be entirely stratigraphic. Within the Venango oil-sand group a porous sand rarely is "dry," and the limits of the productive areas usually coincide with the edges of the thick parts of the sand bodies.

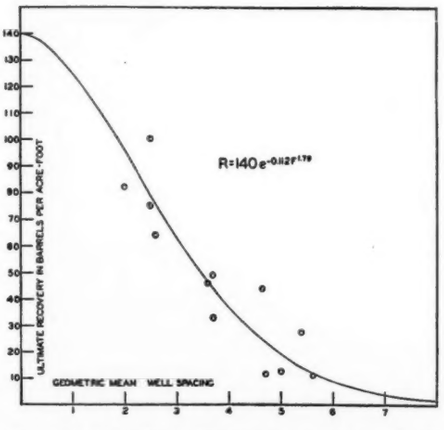

Fig. 1—Relationship between well spacing and ultimate recovery in barrels per acre-foot

Connate water is present in all pools in locally variable quantities. It usually fills 40 to 60 per cent of the pore volume of the sands. Original or encroaching edge water, as usually understood, has never been known to exist in the Venango pools. Water floods, resulting from accidental influx of water, have occurred in several of the thicker and more permeable conglomerate lenses, but the advancing flood seldom penetrated the finer-grained parts of the sand. Most of these floods have been removed by long-continued pumping.

The most productive pools all were found and thoroughly drilled within 20 years after completion of the Drake well in 1859. Unfortunately al-

TABLE 1—VENANGO OIL-FIELD SECTION

System—	Group—	Formation—	Thickness (ft.)	
Pennsylvanian	Pottsville		0 to 100	
Mississippian	Burgoon	Shenango shale	50 to 200	
		Shenango sandstone	20 to 80	
	Cuyahoga	Undifferentiated	100 to 150	
	Berea	Corry sandstone	15 to 30	
		Cussewago sandstone and shale	80 to 100	
Devonian	Conewango	Riceville shale	100 to 150	
		First sand	40 to 80	
		Shale	40 to 70	
		Red Valley sand	10 to 30	
		Shale	10 to 30	
		Second or salt sand	10 to 30	Venango oil sands
		Shale	80 to 110	
		Third stray or black-oil sand	5 to 50	
		Shale	10 to 35	
		Third or green-oil sand	5 to 50	

*Published by permission of the state geologist of Pennsylvania and Brundred Oil Corp.

most no production records are available for this period. New drilling has continued sporadically to the present day. There were periods of increased activity about 1890 to 1910, 1918 to 1923 when vacuum was introduced, and 1925 to 1930 when the use of air drive became common. Most leases thus have passed through four stages with intermediate periods of complete or partial abandonment: (*a*) discovery and period of flush production; (*b*) renewed drilling with some additional production about 30 years later; (*c*) about 1920 intense application of vacuum, with the removal of nearly all the gas and much of the gasoline content of the crude; and (*d*) secondary recovery by air drive.

Method of Air Injection

The injection of air into sands to stimulate the production of oil first was attempted on a commercial scale by I. L. Dunn near Chester Hill, Ohio, in 1911. Rights for the use of the process were acquired by the Brundred Oil Co. of Oil City, Pa., in 1914. The patents later were declared invalid.

The method first was used in Pennsylvania on a property at Hamilton Corners, near Oil City[4,5] in 1916, and since then it has been in continuous application there. The method did not become widespread in the district until about 1927.

At present common practice is to introduce air into especially drilled air-intake wells. These wells are cored in the sand, and the samples analyzed for permeability, porosity, oil, and water content. If, as is usually the case, the permeabilities show wide variations, the sand is segregated into from two to five parts, and packers are set so that the air can be injected into the different sand sections under different pressures. A manifold with separator orifice-meter connections is installed at the well heads, and gage valves adjusted so that 1,000 cu. ft. of air will be injected per day per vertical foot of sand. Pressures necessary to inject this quantity of air range from 50 to 400 lb. per sq. in. There is occasionally a "breakdown pressure," or critical pressure, below which little or no air enters a sand, and above which the volume of air entering is a direct function of the pressure.

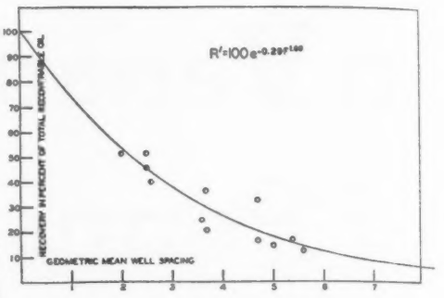

Fig. 2—Relationship between well spacing and recovery in per cent of recoverable contents

In general, pressure wells are located with respect to old wells, so that as symmetrical a well-spacing pattern as possible will be obtained. This results, at best, in irregular patterns and wide variations in spacing. More recent intensive development programs have been based on uniform "seven-spot" patterns, drilling both new intake and output wells with spacings from 150 to 250 ft. (0.67 to 1.85 acres per oil well, and 1.34 to 3.70 acres per air well).

Compressor plants range from small makeshift outfits to large two-stage compressors with capacity up to 1,000,000 cu. ft. per day at pressures up to 400 lb. per sq. in.

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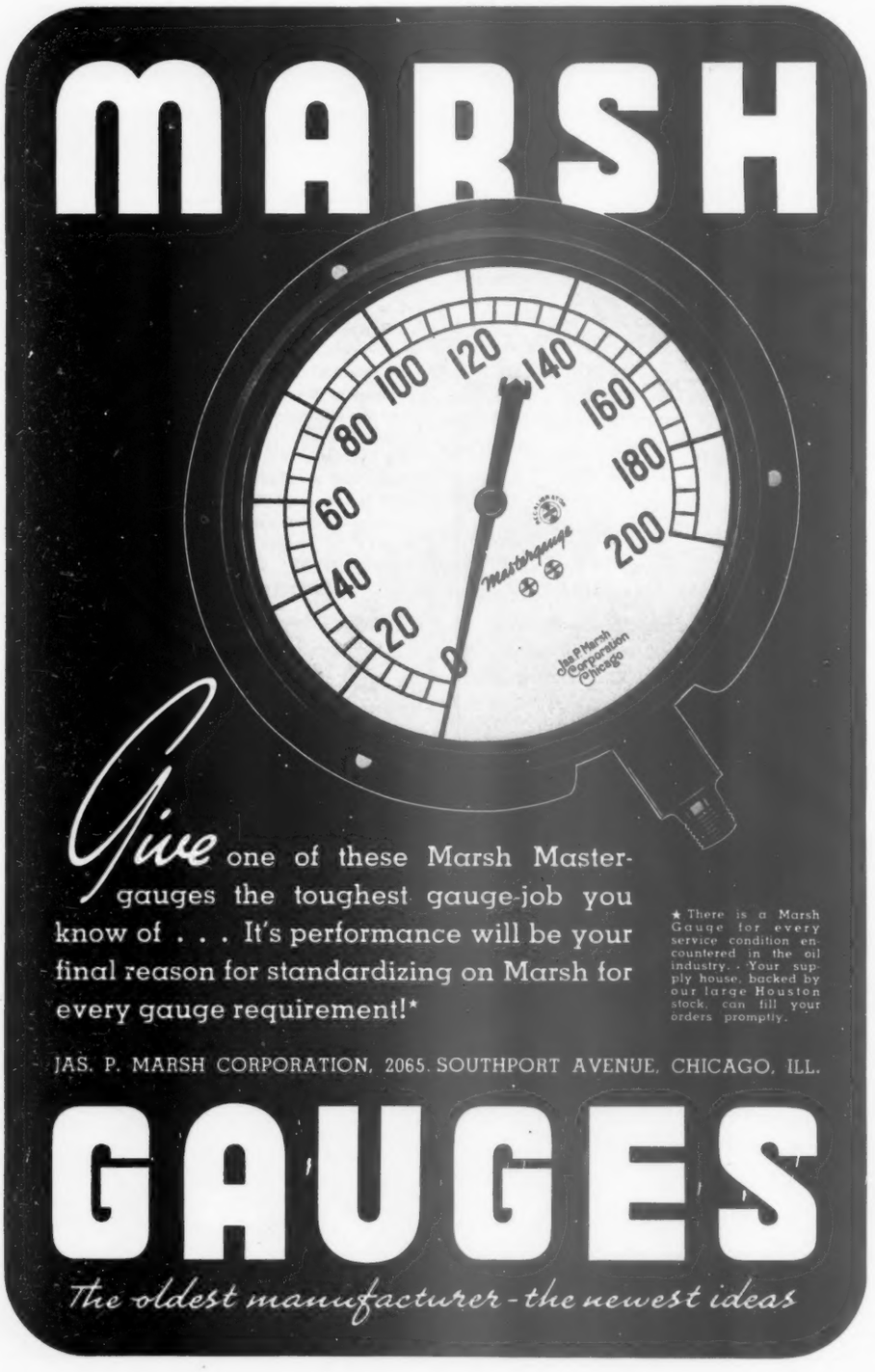
Oil Recoveries Under Air Drive

The writers know of no estimates of the ultimate oil recovery possible under air drive, except by the application of a "recovery factor" to the computed oil content. These recovery factors, which range from 25 to 45 per cent, apparently are not based quantitatively on the results of a wide variety of operating conditions and do not take into account variations in well spacing. Another and sounder method is to assume that the oil contained in the sand in excess of a certain residual saturation is recoverable. A reliable estimate of the quantity of oil recoverable from a sand of known oil content is highly desirable for proper accounting and efficient operating practices.

If the production rate of a group of oil wells shows a decline, and this decline follows an equation of definite type whose constants can be evaluated, it may be assumed that the production will continue to follow the same equation. Therefore, by solving the equation, the production rate can be predicted for any future date. It has been shown[6,7] that for the primary methods of production, in which water drives are unimportant or nonexistent, all production-decline curves belong to the family of hyperbolas represented by the equation:

$$y - A = k\,(x - B)^{-n}$$

Where: y equals production in unit time; x equals time units; A, k, B, and n equal constants.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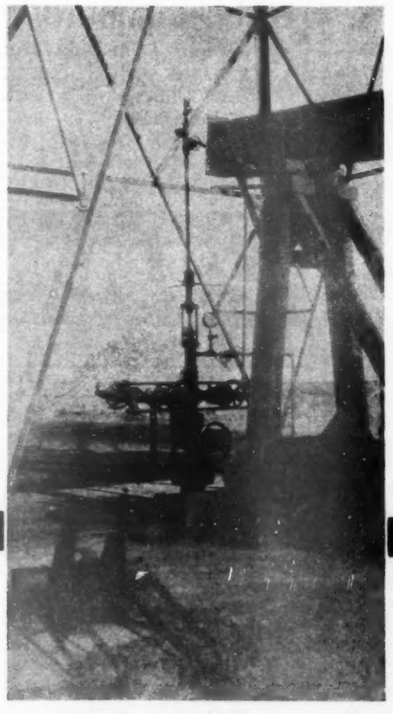

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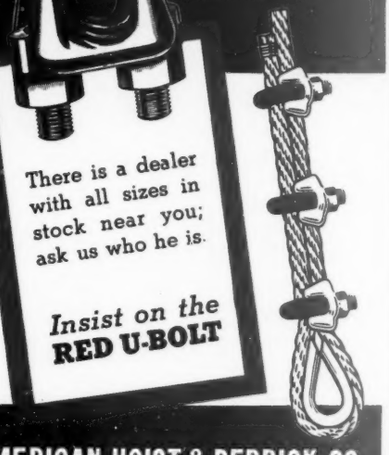

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Curves of this type are straight lines when plotted in a certain position on logarithmic paper. This method of predicting future production has been in use for more than 20 years when wells are permitted to produce with no restriction of production rates. The quantity of oil produced before the rate of production becomes so small that it no longer pays to operate the wells is called the "cumulative ultimate production."

Some 50 Leases Studied

The production history of some 50 leases in the Venango fields was studied, and on most leases new drilling and mechanical improvements either maintained production rate or periodically interrupted its decline. Drilling new oil or air wells introduces a new set of controlling conditions, and changes the constants in the equation of the decline curve. Under secondary methods of recovery, mechanical influences such as compressor shutdowns, frequent pulling of wells, freezing of oil and gas lines affect the production to a much greater degree than during primary production and, as a result, the production curves of all the leases are very irregular. In one instance the appointment of a conscientious superintendent—without any new drilling—resulted in increasing the production rate to a point which it had passed 10 years previously. Consequently the only leases showing a decline and for which the production rates could be extrapolated were those on which no new work had been done for at least 5 years. It was impossible to determine the oil-production declines of leases with regular and close spacing, because on every such lease development programs are still under way and individual well gages are not available.

It was found that the decline curves of leases which, as far as could be learned, had undergone no changes in operating conditions are approximately straight lines on logarithmic paper. They thus show the same type of curve as under primary-recovery methods.

No theoretical reasons here are adduced why oil-production decline under air drive should follow this type of curve. The results of unpublished laboratory work performed at the Pennsylvania State College, on long cores taken parallel to the bedding planes and saturated with oil which then was driven out with compressed air, show similar straight-line "production-decline" curves on logarithmic paper. In some cases the production increased for a time along a straight line with a positive slope. The production of some leases similarly often shows declines of two different slopes. The change in slope probably is caused by a change in the manner of movement of oil through the sand. At first much of the oil is banked and moved bodily by the air; later the air opens many channels through which the oil is moved only by viscous drag.

Oil-Production Curves

Oil-production curves of the first were plotted on coordinate paper. In some cases the monthly oil production per well, and in others the monthly production of the whole lease, was plotted. Some curves show the actual production by months; others show the average monthly production by years. The same data then were plotted on logarithmic paper; and if a straight line could be drawn approximately through the points, it was extended to the economic limit of 3 bbl. of oil per well per month. This economic limit is too low for an intensive project, but is about average production of the pumping wells in the district. Most wells unaffected by air drive produce less than 3 bbl. of oil per well per month.

The actual production from the time the air began to take effect, through December 1939, then was added to the estimated future production from the beginning of 1940 until the economic limit was reached, to ascertain the cumulative oil

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recovery for the lease. On many leases the air did not affect all the wells. For such leases a line was drawn around the area affected by injected air. The line was located midway between the wells which showed a pronounced increase when pressure was begun and wells which showed no large increase. The area within this line was measured by planimeter and considered to be the area affected by air. The oil contributed by the wells unaffected by air was estimated by extrapolating the part of the production curve prior to the application of air and estimating the average production per well for each year if air had not been injected. The cumulative production of these wells then was subtracted from the cumulative ultimate production of the lease to give the cumulative ultimate oil recovery from the area affected by air. This seemed to be the only way to allow for the "unaffected" wells, but it is highly probable that they also were affected to a certain extent by the injected air. One lease, for example, that had no input wells showed a marked and sustained increase in production when a single air-input well was operated on a neighboring lease.

The amount of oil which the wells within the area affected would have produced without the injection of air is included in the extrapolated decline curves. The estimates of ultimate recovery, therefore, are for the total oil production, and not simply for the increase in production due to air drive.

The cumulative ultimate oil production divided by the acreage (measured by planimeter) affected by the injected air gives the recovery per acre. This figure divided by the aggregate thickness of the "pay" sand beds, as indicated by the cores, gives the recovery of oil per acre-foot.

Ultimate Oil Recoveries From 12 Leases

The cumulative ultimate recovery under air drive, as estimated from the production-decline curves, ranged from 11 to 100 bbl. of oil per acre-foot, with an average of 42 bbl. The estimated time required for production to reach the economic limit varied from 9 to 42 years, and averaged 28 years. Most of the oil was recovered during the early part of the period. The time required to get one-half of the ultimate recovery ranged from 2½ to 15 years, being usually about one-third the time to the economic limit. It seems that the time should depend on the spacing of the wells, the oil content of the sand, its permeability, and intensity of air injection. With more data it may be possible to establish a relationship between these variables.

Records showing the quantity of air injected are available for a few leases only, and for others they are very rough estimates. The average quantity of air injected is 86 cu. ft. per day per acre-foot of sand. The total input of air per barrel of oil recovered varies for any lease, and increases as the production declines and the input remains constant. The ratio of air injected to oil recovered was calculated for certain leases; using the cumulative air input from the time air was applied to the end of 1939, divided by the oil produced during the same period, was found to range from 6 to 22 cu. ft. per bbl., with an average of 15.3 cu. ft.

The well spacings on the different leases were determined by dividing the productive area affected by air (as measured by planimeter) by the number of input and output wells. Acres per oil well range from 1.2 to 3.1, and per air well from 3.4 to 14.5. The average is 2.1 acres per oil well and 8.0 acres per air well, which corresponds to a well-to-well distance of 300 ft. for oil wells and 570 ft. for air wells. There are no uniform well-spacing patterns in the leases studied.

The oil content of the sand was estimated from the core reports for the most part made during

the development program. On some leases enough cores had been taken to determine the content with some degree of accuracy, but for others it was necessary to assume that one or two cores on the lease or on adjacent leases are representative of the entire productive area. For some leases the estimates, therefore, may be seriously in error. The average oil content was calculated to be 287 bbl. per acre-foot; the average porosity of the

TABLE 2—PRODUCTION AND OPERATING DATA FROM 12 LEASES UNDER AIR DRIVE SHOWING UNINTERRUPTED DECLINE CURVES

	1	2	3	4	5	6	7	8	9	10	**11	**11	12	Average
1. Acres within lease affected by air	76	60	35	40	260	45	133	61	61	16	50	24	37	...
2. Oil wells affected by air	26	20	17	16	76	23	62	30	34	12	33	20	27	...
3. Effective air wells (line wells count one-half)	7	8	3	3½	18	6½	13	9½	8	3	12	7	8	...
4. Acres affected by air divided by number of oil wells	2.9	3.0	2.2	2.5	3.4	1.95	2.14	2.03	1.8	1.3	1.5	1.2	1.37	2.1
5. Acres affected by air divided by number of effective air wells	10.8	7.5	11.6	11.5	14.5	7.0	10.2	6.4	7.6	5.4	4.1	3.4	4.6	8.0
6. Name of sand	Third	Second	Third stray	First and second	First	First and second	Second and third	Second	Third	Third stray	Second and third stray	Second and third stray	First	...
7. Thickness of sand (feet)	20	35	20	30	20	20 (Estimated)	35	24	37	40	20	20	22	...
8. Average porosity of sand (per cent)	12	13	12	...	22	...	13	16	13	15	15	15	17	14.8
9. Average oil saturation of sand (per cent pore space occupied by oil)	24	...	20	...	23	...	...	16	...	23	26	26	25	22.8
10. Average oil content of sand (barrels per acre-foot)	230	210	225	300	330	300 (Estimated)	275	325	275	300	300	300	360	287
11. Year air drive was initiated	1936	1928	1929	1930	1915	1926	1926	1928	1930	1933	1926	1926	1935	...
12. Cumulative oil recovery with air drive from that year until December 31, 1939	11,500	12,571	*6,001	27,978	146,164	25,600	114,200	48,882	53,046	19,900	¶25,260	‡7,400	44,300	...
13. Estimated future oil production, January 1, 1940, to economic limit	6,800	11,800	†2,750	42,000	52,000	7,000	92,000	26,900	58,000	25,300	‖50,000	§32,000	36,000	...
14. Expected date of economic limit	1944	1954	1938	1965	1954	1943	1967	1951	1969	1955	1966	1955	1954	...
15. Number of oil wells contributing but unaffected by air	5	...	...	18	None	8	...	15	None	6	...	...	...	...
16. Estimated production of oil wells contributing but unaffected by air, from date of initiation of air drive to economic limit	1,300	...	...	37,000	None	3,000	..	7,800	None	3,900	...	...	...	...
17. Estimated cumulative ultimate oil recovery with air, from date air drive was initiated to economic limit (barrels)	17,000	24,400	8,750	33,000	198,000	30,000	206,200	68,000	111,000	41,100	75,260	39,400	80,300	...
18. Estimated cumulative ultimate oil recovery per acre	220	407	250	825	760	660	1,550	1,100	1,800	2,570	1,500	1,640	2,175	...
19. Estimated cumulative ultimate oil recovery per acre-foot	11	11.5	12.5	27.5	38	33	44	46	49	64	75	82	100	43.1
20. Average daily air input—date of initiation through 1939 (thousands of cubic feet)	...	65	...	120	...	...	250	275	220	...	...	...	110	...
21. Estimated air input per barrel recovery—date of initiation to December 31, 1939 (thousands of cubic feet per barrel)	...	21.9	...	15.6	...	...	11.0	23.6	15.6	...	...	...	5.6	15.3
22. Time from initiation of air drive until production is less than 3 bbl. per month per well (economic limit) (years)	9	27	10	36	40	18	42	24	40	23	41	30	20	28
23. Time from initiation of air drive until one-half the ultimate recovery is obtained (years)	2½	11	3	15	11	7	13	8½	11	8½	14	10	4	9½
24. Spacing factor; square root of the product, acres per air well times acres per oil well	5.6	4.7	5.0	5.36	7.0	3.70	4.66	3.61	3.70	2.65	2.48	2.02	2.51	4.1

*Actual oil production, 1929-1933. †Estimated future oil production, 1934-1938. ‡Actual oil production, 1926-1929. §Estimated future oil production, 1930-1955. ¶Actual oil production, 1926-1934. ‖Estimated future oil production, 1935-1966. **Two periods of decline following two periods of drilling on same lease.

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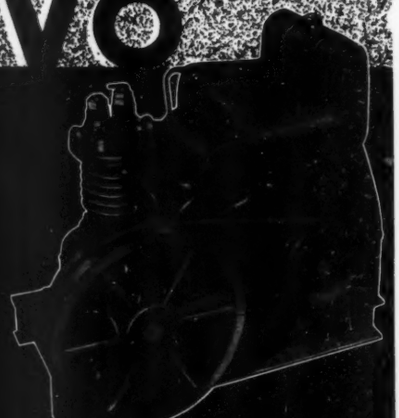

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sand 14.8 per cent; and the average saturation of oil 22.8 per cent of the pore volume.

Production and operating data for the 12 leases under air drive are given in Table 2.

Factors Affecting Recovery of Oil by Air Drive

Bypassing of air.—As the permeability of the sands of the Venango group is extremely variable as noted above, it is almost impossible to prevent most of the air from passing through the most permeable beds only. The air removes the fluids from these beds preferentially, thereby still further increasing their permeability to air. It is probable that channeling by the air takes place to a certain extent around every well. An exceedingly permeable sand will take large quantities of air at low pressure, and the injected air almost directly passes to a nearby output well. The air then has little effect in moving the oil in the other parts of the sand. It is obvious that even a small amount of bypassing may result in highly inefficient extraction of oil.

The most convenient way to determine the extent of bypassing of air is to take open-flow gages of the air-gas output of the producing wells. An alternative method is to note the pressure build-up with time, as in gaging gas wells. These measurements often are supplemented by approximate analysis of the gas, either for B.t.u. content or by noting the color of the flame when ignited.

Methods of controlling bypassing of air.—The use of multiple packers, as already mentioned, has become general practice in the Venango fields.

If an oil-producing well shows serious bypassing of air due to directional channeling, it is common practice to stop pumping for a time and allow a liquid head to build up in the well. The oil or water tends to enter the sand and plug the more permeable streaks, and bypassing of air often is stopped temporarily. Filling the well with fresh or salt water and allowing it to stand in the well until some of the liquid has penetrated the sands also has proven effective. Selective plugging by means of chemicals has been suggested, but never attempted, in the Venango fields.

It has been found that injecting air intermittently in 4, 8, or 12-hour cycles tends to inhibit bypassing. This probably is because large fluctuations of pressure occur in the open channels, and smaller fluctuations of pressure in the tighter parts of the sand where there is also more liquid. When the pressure drops in the open channels, the liquids—being at a higher pressure—tend to migrate from the tight parts of the sand. During the next period of injection the liquids are forced along the open channels toward the producing well. The presence of the liquids in the open channels decreases their effective permeability, and the air is forced to act on the other parts of the sand. When bypassing is severe, very short injection cycles are beneficial.

Oil content of sands.—It is obvious that the more oil in the sand when repressuring begins, the greater will be the recovery. It is certain also that a considerable quantity of oil in the sand cannot possibly be recovered economically by air drive. Laboratory work on fully oil-saturated cores indicates that 40 to 50 per cent of the oil cannot be removed by air. When the cores are saturated first with water and then with oil, however, the oil remaining after prolonged air drives may be as low as 20 per cent. On one property a pressure well, from which air bypassed extensively through a permeable bed, was abandoned for mechanical reasons, and a new well drilled 40 ft. away. It was found that the saturation in the permeable bed, through which large quantities of air must have passed, was 12.5 per cent, equivalent to 124 bbl. of oil per acre-foot. Experience indicates that probably very little oil can be recovered from a sand with an oil satura-

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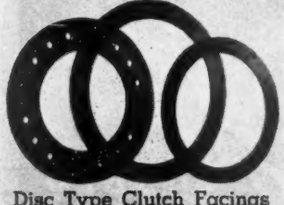

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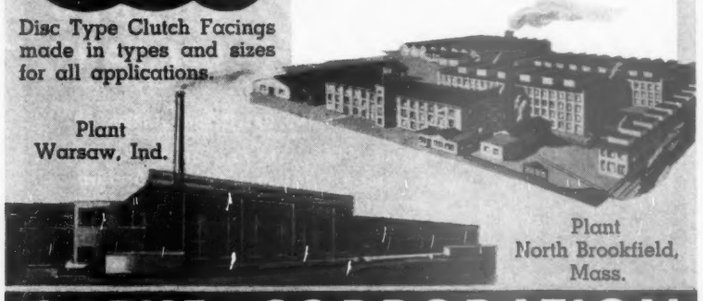

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Spacing and pattern of wells.—Results in both the field and laboratory indicate that the longer air passes through a sand, the more oil is recovered, and that the rate of production decreases with time and approaches zero asymptotically. The cumulative production of oil from unit volume of sand is, therefore, some function of the quantity of air which has passed through it.

It is obvious that different volumes of air pass through unit volumes of sand in different parts of the sand body. For example, in a seven-spot pattern in a homogeneous sand all the air injected must pass through the sand and come out at the producing wells. The volume of air passing through unit cross-section of the sand—which we may call flux density—is greatest at the walls of the holes, and decreases out in the sand away from them. Greater volumes of air come out at the producing wells then go into the input wells, because the outlet pressures are much lower than the input pressures. If the pressure at the input wells is 300 lb. per sq. in. (gage) and is atmospheric at the producing well, the volume of air emitted will be 21 times the volume injected. There are twice as many producing as input wells in a seven-spot pattern; hence, the flux densities in the neighborhood of the producing wells will approach 10 times those in the neighborhood of the input wells.

Between the input and output wells in a seven-spot pattern the air spreads out until, at three-fourths of the distance from input to output well, it covers a path 0.86 of the well-to-well distance in width. The greatest flow of air takes place along the straight line connecting the input and output wells, and decreases to zero at the points midway between the producing wells. Areas such as these, through which little or no air passes, will be very common in irregular patterns, and the oil actually may be concentrated in them. Pressure wells drilled recently between old oil wells on a lease, which had been subject to air drive for more than 20 years, showed abnormally high saturations, which were unquestionably due to secondary enrichment.

Problems involving the flow of gases through porous media are more complicated than the flow of incompressible fluids. For liquids, the pressure distribution can be worked out by electrolytic conduction models, no matter how irregular the pattern. Theoretical work showing the distribution of the flux densities for gases likewise would be instructive, and would permit determining the relative efficiencies of various patterns. Efficiency is used here in a sense different from that used in connection with water flooding, and the pattern that gives the most uniform distribution of flux density between wells is considered the most efficient.

Although the importance of efficient patterns needs emphasis, irregularities in the sand body will spoil the efficiency of any regular pattern. Recent geological work has shown that some of the sand bodies in the Venango fields consist of a series of long parallel bars or thick streaks, 1,000 ft. to 2,000 ft. wide. Between the bars the sand is much thinner, and apparently also less porous and permeable than in the thick streaks. Whenever possible, the location of such impermeable streaks and spots should be given full consideration in a layout of well patterns.

Other factors.—Air has an oxidizing effect on crude oil, forming compounds that make the oil more difficult to recover. Some of these compounds are insoluble, and tend to clog the pores of the sand; others cause stable oil-water emulsions. The long-continued passage of air through oil sands removes many of the lighter hydrocarbons, and increases the gravity and viscosity of the oil. The use of air introduces other mechanical difficulties, such as corrosion of equipment and the formation of explosive mixtures.

Better oil recoveries than are possible with air as the injection medium might be obtained by driving with a gas that is soluble in the oil. Gas coming out of solution forms bubbles that tend to clog the pores of the sand, which otherwise would transmit gas only. On the other hand, some of the driving effects would be lost as a result of the gas going into solution.

Although it might be difficult to show that the advantages of natural gas as a driving medium justify its purchase at a price in excess of 40 cents per 1,000 cu. ft., the gas still remaining in the sand carefully should be conserved by using outside sources of power and by collecting vapors produced with the oil from flow lines and receiving tanks.

Other factors that have an important effect on oil recovery by air drive are the viscosity of the oil, the per cent pore space of the sand occupied by water, and the permeability of the sand. It is believed, however, that the effect of these factors on the recoveries of oil from the leases studied was less than the effect of the bypassing of air, oil content, and well spacing. These factors are more susceptible to laboratory investigation than the major ones. Insufficient data were available to attempt to evaluate their importance.

Fundamentally, it is the energy of the expanding and moving air that moves oil to the wells, and energy input can be calculated from the volume and pressure of input air. However, bypassing causes such a variable and unknown waste of energy, and inefficiencies of pattern cause such a variable distribution, that it is difficult to estimate the quantity of energy required to recover a barrel of oil.

It would be desirable, as a guide to operation, if the relationship between the foregoing factors and oil recovery were understood clearly. If, for

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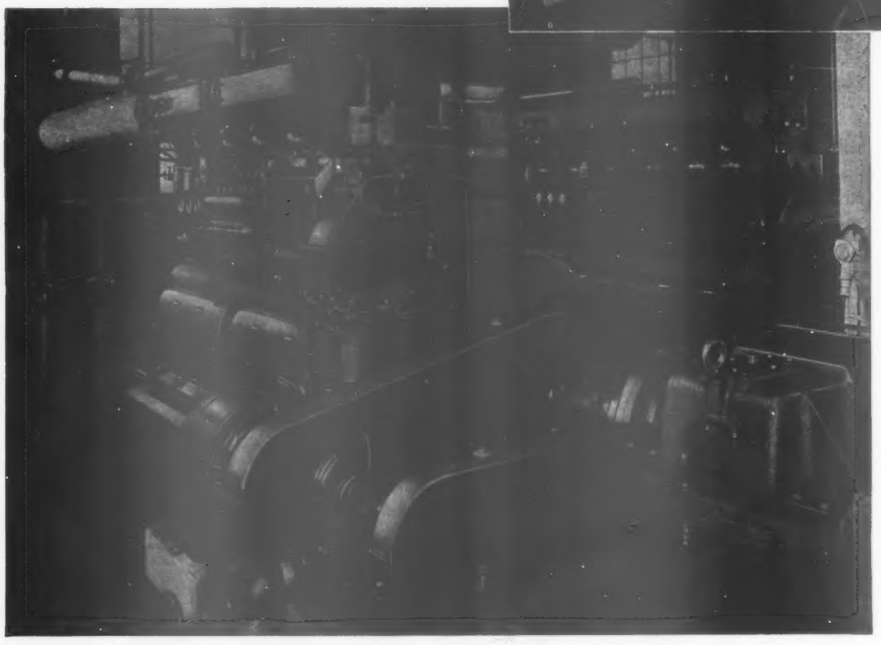

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example, the relation between oil recovery and well spacing were known, it would be possible to calculate the optimum spacing for a sand of given character.

It is difficult to arrive at an expression for well spacing in an air-drive operation, especially when the wells do not lie in a geometric pattern. Assuming that, within limits, the recovery will vary inversely with either the acres per oil well or acres per air well, it seemed reasonable to use the geometric mean of these values. The cumulative ultimate recoveries from the leases studied were plotted against a spacing factor consisting of the square root of the product, acres per oil well times acres per air well. The points scatter badly, as might be expected from the different sand characteristics, amount of bypassing of air, oil content, and pattern efficiency, but there does appear to be a definite relationship (Fig. 1).

The points are too scattered, and there are not enough of them to indicate the true character of the curve; but it is possible to speculate concerning its general shape and perhaps arrive at its approximate equation. If the well spacing is decreased to small values, which mean absurdly short well-to-well distances, the oil recovery will increase more and more slowly, tending to approach as a limit the total amount of recoverable oil in the sand. At the other (right-hand) end of the curve, where the spacing becomes so great that the air wells do not affect the oil wells and there are fewer and fewer wells to drain the sand, the recovery will approach zero.

A curve of this shape may be expressed by the general formula:

$$y = ae^{-bx^p}$$

In the lack of enough points to define the curve more completely, it will be necessary to assume a reasonable value for a, which is the total recoverable oil in the sand. Various lines of evidence seem to indicate that the residual oil which cannot be removed from an oil sand by air or water drive is between 100 bbl. and 150 bbl. per acre-foot. Laboratory work indicates that, by driving oil from sands partly saturated with oil and water, it is impossible to reduce the oil saturation much below 15 per cent. Actual oil sands in the Venango district which had transmitted large quantities of air over a period of years had their saturation reduced to between 12 and 15 per cent. The average oil content of these leases included in Fig. 1 is 290 bbl. per acre-foot. If 150 bbl. of this oil is unrecoverable, then the maximum possible oil recovery from this group of leases will be 140 bbl. per acre-foot. The constant a, therefore, may be assumed to be 140. Values then may be assigned as follows:

$y = R$ = cumulative ultimate recovery, barrels per acre-foot.
$x = F$ = square root of the product, acres per oil well times acres per air well.
$a = 140$.
$e = 2.7183$ (base of Naperian logarithms).

By assuming these values and fittings a curve to the plotted points by the method of least squares, the equation becomes:

$$R = 140e^{-0.112F^{1.79}}$$

This curve, however, cannot be used to relate well spacing and recovery, because the leases with the higher recovery have a greater oil content per acre-foot than the leases with low recovery. This may be taken into account by expressing recovery as per cent of total recoverable oil recovered before the economic limit is reached, i.e.:

$$R' = \frac{R(100)}{C - 140}$$

where
R' = per cent recovery of maximum possible.
R = cumulative ultimate recovery, barrels per acre-foot.
C = original oil content of sand, barrels per acre-foot.

The per cent recovery of maximum possible, R', is plotted against the same spacing factor in Fig. 2. The curve which best fits these points has the equation:

$$R' = 100e^{-0.29F^{1.09}}$$

With this relationship available, the optimum spacing may be calculated by any method preferred.

The purpose of these calculations has been not so much to establish the relationship between well spacing and oil recovery for general use as to indicate what might be done with more data. The points are too few to define with any degree of certainty the equation or its constants. It is hoped that this paper may encourage some operators to make ultimate-recovery estimates for their leases which, in sufficient numbers, would provide reliable equations on which to base development and operating programs.

Summary

The almost complete exhaustion of the gas in the Venango fields of Pennsylvania led to the widespread adoption of the Smith-Dunn or air-injection method of secondary-oil recovery. Certain leases on which no new development work has been done for several years show oil-production-decline curves that are straight lines on logarithmic paper. Thus they can be extrapolated to the economic limit and the cumulative ultimate oil recoveries estimated. These range from 11 bbl. to 100 bbl. per acre-foot.

The cumulative ultimate recoveries depend on a great many factors, but it is thought that the

(Continued on Page 184)

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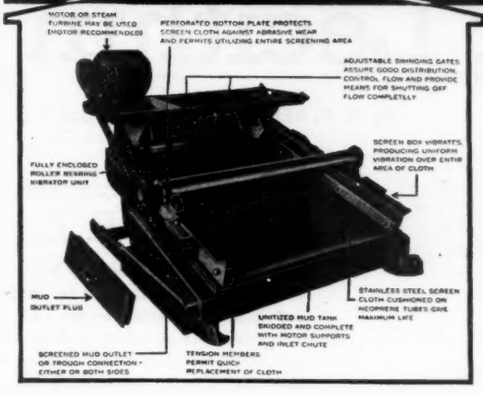
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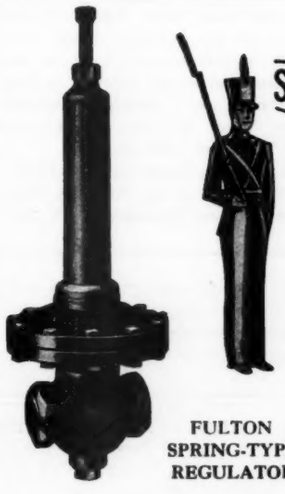

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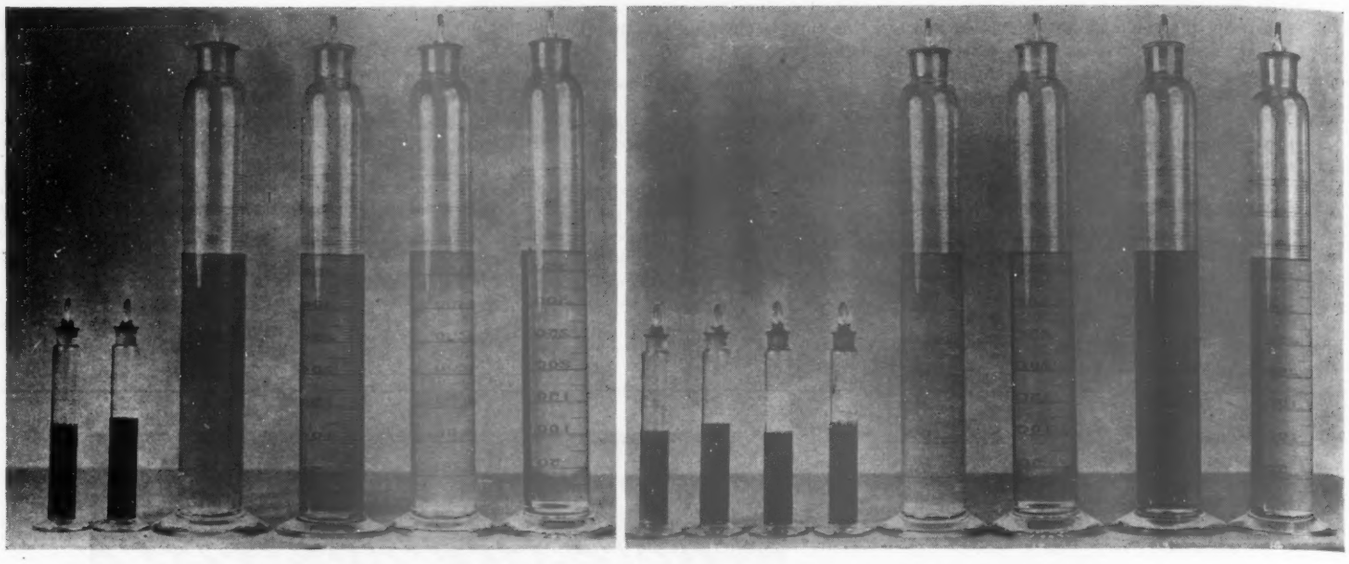
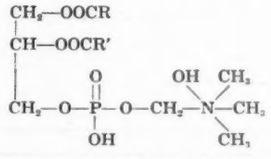


Figs. 1 and 2—Effect of sunlight on leaded gasolines and Ethyl fluid. (Samples are identified in Tables 2 and 3)

Use of Lecithin in Gasoline

By H. V. REES, W. S. QUIMBY and J. C. D. OOSTERHOUT
The Texas Co.

LECITHIN is a fatlike yellow or brownish substance of plastic consistency occurring in all living cells, and is the best known of a group of complex compounds known as phosphatides. Its structure may be depicted as follows:



R represents an unsaturated fatty acid such as oleic and R' represents a saturated acid such as palmitic.

Lecithin forms colloidal solutions and has found various applications as an interface modifier or emulsifier in leather, textile, pigment and food industries.

Until 1928 lecithin was derived wholly from animal sources, chiefly egg yolk, and was rather costly. Today lecithin is commercially prepared from soy beans by solvent extraction with hexane. Commercial soya lecithin includes other phosphatides, especially cephalin, and about 30 per cent of residual oil which imparts excellent storage and handling properties. It contains approximately 2.2 per cent phosphorous and is soluble in benzol, chloroform and petroleum ether, is slightly soluble in alcohol and is insoluble in acetone and water.

A. Effect on Sunlight Stability

Background.—The use of lecithin in gasoline was brought about as the result of a comprehensive study of various additives in an attempt to reduce or prevent the deterioration of both leaded and unleaded gasoline upon exposure to sunlight. Practically every refiner has noted that exposure of his gasoline in pump bowls, even for relatively short periods, results in cloudiness and fading with occasional formation of a whitish deposit.[1,2,3] This cloudiness and deposit, due to the action of sunlight on the gasoline, is accelerated in leaded gasoline due to a gradual decomposition of the soluble tetraethyl lead to an insoluble compound believed to be lead triethyl hydroxide.[3,7]

After the examination of a large number of additives for this purpose, lecithin was found to be the best material and was studied in great detail.[1] The lecithin apparently acts as a peptizing agent or protective colloid, in preventing the formation of a precipitate.

Effect of lecithin on gasoline in sunlight.

Samples of all types of leaded and dyed gasolines were exposed to direct sunlight in glass bottles, varying in size from 1 pt. to 5 gal., fitted with slotted cork stoppers. It was found that different gasolines reacted differently to this test, but in general all samples turned cloudy after an exposure of from a few minutes to several hours, followed by increasing cloudiness and the formation of a white deposit. The color of gasolines was usually affected detrimentally as was the copper-dish gum and octane number.

The addition of lecithin to these gasolines prior to exposure results in a very marked improvement. The data indicated that lecithin retarded the deteriorating action of sunlight, but that the nature of this inhibiting action depended upon the nature of the gasoline, the effect being much less pronounced on straightrun gasoline than on cracked gasoline, as is shown in Tables 1 and 3 and in Figs. 1 and 2.

Samples of ethyl fluid were also exposed to direct sunlight in a similar manner to that mentioned above. Table 2 indicates that lecithin very ma-

A. P. I.

Lecithin, obtained from soy beans, is a phosphatide found to be effective in improving leaded and unleaded gasoline quality and stability. It has little effect on initial or dark storage color, but markedly reduces decolorization as well as haze and deposit formation when exposed to sunlight, as in gasoline-dispensing pumps. Its use results in decreased corrosion of storage-tank bottoms and of galvanized drums, particularly those containing highly leaded aviation gasolines in which the formation of zinc oxide deposits often requires filtration prior to consumption. Reduced aluminum corrosion in aviation-gasoline tanks due to moisture condensation also was found. Dosages required range from 1 lb. to 15 lb. per 1,000 bbl.

Paper was presented before Division of Refining at annual meeting of the American Petroleum Institute, Chicago, November 11-15, 1940.

TABLE 1—EFFECT OF LECITHIN IN VARIOUS TYPES OF GASOLINE
(All samples contain 0.6 ml. TEL per gallon and dye)

Sample No.	Gasoline type—	Treatment	Lecithin dosage lb./1,000 bbl.	Sunlight exposure—Time for cloud formation Without lecithin	With lecithin
1.	Cracked	Doctor	15	40 min.	12 hours
2.	Cracked	Acid, caustic, steam still, doctor	15	45 min.	16 hours
3.	Cracked	Acid, caustic, clay vapor treated, doctor	15	40 min.	5 hours
4.	Straightrun	Doctor	15	25 min.	2¾ hours
5.	Blend 60 per cent No. 2, 40 per cent No. 4		15	45 min.	12 hours
6.	Blend 60 per cent No. 3, 40 per cent No. 4		15	45 min.	8 hours

terially improved the sunlight stability of ethyl fluid and was the only one of a large number of compounds tried which had this effect. Fig. 1, Samples 1 and 2, and Fig. 2, Samples 7, 8, 9 and 10, show the resulting fluids after this test.

Larger amounts of lecithin even further increased the sunlight stability and higher dosages of TEL required additional quantities of lecithin for prevention of cloudiness.

Lecithin was found to have no effect on initial octane or TEL susceptibility. Although a slight reduction in octane through loss of light fractions during the sunlight-exposure test was found in all cases, very little additional octane loss was noted in samples which were only slightly cloudy over those which remained clear, but up to 12 octane numbers were lost on certain samples which formed heavy cloud and deposits. This reduction in octane appears to be related to the amount of cloud formed and for similar-type gasolines appears to be proportional to the amount of TEL present in the original samples.

The copper-dish gum test (Atlantic Refining Co. method) of the base gasoline before sunlight exposure was not materially affected by lecithin at values below 20-30 mg. per 100 cc. In the majority of cases, an increase of less than 5 mg. was noted in this range.[4] At high copper-dish gum values, above 70-100 mg. per 100 cc., a reduction was generally noted. Lecithin, therefore, appears to inhibit TEL decomposition and does not act as a strong gum inhibitor.[2] After sunlight exposure, however, the base gasolines containing cracked components showed considerably increased copper-dish gum values, but the action of lecithin was such as to minimize the detrimental effect of the exposure.

The effect of lecithin on the Saybolt color of the base gasoline before leading and dyeing was found to be negligible. The colors of the leaded samples after exposure, however, were found to vary from pink to yellow when using either red or copper-colored samples as shown in Table 3.

Effect of sulfur compounds on sunlight stability.

The sunlight stability of leaded gasolines was noted to be related to their sulfur content. It was found that doctor sweetening, using a minimum amount of sulfur, resulted in slightly better sun tests, due to the formation of a minimum amount of polysulfides. Sweetening before steam stilling also resulted in lower sulfur-content stock with better sunlight stability through a reduction in the amount of free and disulfide sulfur present, as shown in Table 4, and rendered the gasoline much more susceptible to the stabilizing effect of lecithin.

A fundamental study of the effect of free sulfur, organic sulfides and di- and polysulfides was accordingly conducted. Table 5 indicates that elementary sulfur acts as an accelerator of the action of sunlight in leaded gasoline. Inasmuch as the use of the usual copper-strip corrosion test or the Universal Oil Products Co. butyl-mercaptan test limits free sulfur to a very small amount, little trouble should be experienced in this connection, provided the sweetening operation is carefully controlled.

Copper sweetening was also investigated and gasolines so sweetened were found to have sunlight stabilities essentially equal to samples sweetened by the carefully controlled doctor method, and also benefited by the use of lecithin.

Effect of lecithin in pure leaded organic compounds.

An attempt was made to determine the reasor why lecithin is so much more effective in retarding the effect of sunlight on cracked gasolines than on straightrun gasolines. It was believed that working with pure organic compounds might furnish some light on the matter.

Accordingly samples of isooctane, cyclohexane and xylene were leaded with 0.8 ml. of TEL per gal. and exposed to sunlight for 2 days. Lecithin affords protection in all three cases, but it is least effective with the isoparaffin tested, as shown in Table 6.

Effects of components of lecithin on sunlight exposure.

Since lecithin is derived from the choline ester of palmitic, stearic or oleic ester of glycerylphosphoric acid, its properties might possibly be due to one or more of these groups. Therefore, samples

TABLE 2—EFFECT OF LECITHIN ON SUNLIGHT STABILITY (3-HOUR EXPOSURE) OF ETHYL FLUID

	Cloud and deposit formation, time in hours			Color	
	Clear for	Very cloudy after	Deposit after	Initial	After 3 hours
Fig. 1, Sample 1—Ethyl fluid	1/4	1/2	1/2	Yellow	
Fig. 1, Sample 2—Sample 1 + 10 per cent lecithin	3+	...	.....	Yellow	Slightly faded yellow
Fig. 2, Sample 7—Same as Sample 1	.....	...	.....	.....	.....
Fig. 2, Sample 8—Same as Sample 2	.....	...	.....	.....	.....
Fig. 2, Sample 9—Sample 1 + 5 per cent alpha-naphthol	Black	...	18 hr. settling	Yellow	Black
Fig. 2, Sample 10—Sample 1 + 3 per cent monobenzyl para aminophenol	Black	...	18 hr. settling	Yellow	Black

TABLE 3—EFFECT OF LECITHIN ON SUNLIGHT STABILITY (3-HOUR EXPOSURE) OF LEADED GASOLINE

(All samples contain 1.5 ml. TEL per gallon and dye)

Identification—	Cloud and deposit formation, time in hours			Color		Initial copper dish gum, mgs. /100 ml.	Initial A.S.T.M. gum, mgs. /100 ml.
	Clear for	Very cloudy after	Deposit found after	Initial	After 3 hours		
Sample 1—Doctor-sweetened cracked gasoline	1/6	Unreported	Unreported	Copper	Yellowish	77	4
Sample 2—Sample 1 + lecithin (15 lb./1,000 bbl.)	3+	...	.....	Copper	Light copper	17	2
Fig. 1, Sample 3—Sample 1 + alpha-naphthol (30 lb./1,000 bbl.)	1/6	1/2	18 hr. settling	Copper	Yellowish	16	5
Fig. 1, Sample 4—Sample 1 + alpha-naphthol (30 lb./1,000 bbl.) + lecithin (15 lb./1,000 bbl.)	3+	...	.....	Copper	Light copper	19	4
Fig. 1, Sample 5—Acid-treated, steam-stilled and doctor-sweetened cracked gasoline	1/3	1	18 hr. settling	Copper	Yellowish	4	3
Fig. 1, Sample 6—Sample 5 + lecithin (15 lb./1,000 bbl.)	3+	...	.....	Copper	Yellowish	8	2
Fig. 2, Sample 11—Acid-treated, steam-stilled and doctor-sweetened cracked gasoline	1/3	1	18 hr. settling	Copper	Yellowish	4	3
Fig. 2, Sample 12—Sample 11 + lecithin (15 lb./1,000 bbl.)	3+	...	.....	Copper	Yellowish	8	2
Fig. 2, Sample 13—Sample 11 + alpha-naphthol (15/1,000 bbl.)	1/4	1/2	18 hr. settling	Copper	Yellowish	5	1
Fig. 2, Sample 14—Sample 11 + monobenzyl para aminophenol (15 lb./1,000 bbl.)	1/4	1/2	18 hr. settling	Copper	Yellowish	5	1
Sample 15—Sample 11 + alpha-naphthol (15 lb./1,000 bbl.) + lecithin (15 lb./1,000 bbl.)	3+	...	.....	Copper	Yellowish	4	1
Sample 16—Sample 11 + monobenzyl para aminophenol (15 lb./1,000 bbl.) + lecithin (15 lb./1,000 bbl.)	3+	...	.....	Copper	Light copper	4	1
Sample 17—Doctor-sweetened straightrun gasoline	1/12	1/4	18 hr. settling	Copper	Pink	7	1
Sample 18—Sample 17 + lecithin (15 lb./1,000 bbl.)	1 1/2	2	18 hr. settling	Copper	Pink	12	3
Sample 19—Sample 17 + lecithin (30 lb./1,000 bbl.)	3+	...	.....	Copper	Pink	...	...

TABLE 4—EFFECT OF STEAM STILLING, BEFORE DOCTOR SWEETENING, ON LECITHIN SUSCEPTIBILITY

(All samples contain 0.8 ml. TEL per gallon)

Sample No.	Gasoline type—	Treatment—	Lecithin dosage lb./1,000 bbl.	Sulfur content per cent	Sunlight exposure time for cloud formation (hr.)		Color	
					Without lecithin	With lecithin	Initial	After 8 hr.
1	Straightrun	Caustic, acid, caustic, doctor, steam still, and doctor	15	0.107	½	8	Copper	Pale copper
2	Straightrun	Caustic, acid, caustic, steam still, and doctor	15	0.253	¼	3½	Copper	Pink

TABLE 5—EFFECT OF SULFUR COMPOUNDS ON SUNLIGHT STABILITY

(All samples contain 0.8 ml. TEL per gallon and dye)

Sample No.	Gasoline type—	Treatment	Lecithin dosage lb./1,000 bbl.	Sunlight exposure time for cloud formation (hr.)		Color	
				Without lecithin	With lecithin	Initial	After 24-hour sun test
1	Straightrun	Doctor	15	¾	2½	Copper	Pale salmon
2	Sample 1 + 0.015 per cent ethyl disulfide	.....	15	¾	2½	Copper	Pale salmon
3	Sample 1 + 0.015 per cent butyl sulfide	.....	15	¾	2½	Copper	Pale salmon
4	Straightrun	Doctor	15	½	2½	Copper	Pale salmon
5	Sample 4 + 0.005 per cent sulfur	.....	15	½	2	Copper	Pale salmon
6	Sample 4 + 0.010 per cent sulfur	.....	15	¾	2	Copper	Pale salmon
7	Sample 4 + 0.010 per cent sulfur + 0.2 per cent ethyl disulfide	.....	15	¼	1½	Copper	Pale salmon
8	Blend 60 per cent cracked, 40 per cent straightrun	Doctor	15	1	24+	Copper	Bleached
9	Sample 8 + 0.002 per cent sulfur	.....	15	¾	8	Copper	Bleached
10	Sample 8 + 0.01 per cent sulfur	.....	15	¾	2½	Copper	Bleached
11	Sample 8 + 0.02 per cent sulfur	.....	15	¼	2	Copper	Bleached
12	Sample 8 + 0.07 per cent ethyl disulfide	.....	15	1	8	Copper	Bleached

of choline and oleic, palmitic and glycerylphosphoric acid were tested separately for their effect on sun stability of leaded gasoline without success. Lecithin alone appears to have the unusual property of stabilizing gasoline in this respect.

Combinations of lecithin with other inhibitors. During the course of this investigation, it was

(Continued on Page 182)

TABLE 6—EFFECTS OF LECITHIN ON PURE LEADED ORGANIC COMPOUNDS CONTAINING 0.8 ML. TEL PER GALLON

Compound—	Lecithin dosage lb./1,000 bbl.	Sunlight exposure, time for cloud formation (hr.)	
		Without lecithin	With lecithin
Isooctane	15	1	5
Cyclohexane	15	1	48+
Xylene	15	1	48+

TABLE 7—EFFECT OF COMBINATIONS OF LECITHIN WITH OTHER INHIBITORS
All samples contain 0.8 ml. TEL per gallon.

Sample No.	Gasoline type—	Treatment—	Lecithin dosage, lb. /1,000 bbl.	Sunlight exposure time for cloud formation (hr.)		Color	
				Without lecithin	With lecithin	Initial	After 24 hr.
1	Blend 70 per cent straightrun, 30 per cent cracked	Acid, caustic, doctor, steam still, doctor	15	¼	1½	Copper	Pale salmon
2	Sample 1 + 7 lb./1,000 bbl. monobenzyl para aminophenol + 0.02 per cent cresylic acid		15	¼	23	Copper	Copper
3	Straightrun	Doctor	10	½	3½	Copper	Pale salmon
4	Sample 3 + 7 lb./1,000 bbl. monobenzyl para aminophenol + 0.02 per cent cresylic acid		10	½	24+	Copper	Copper
5	Cracked	Acid, caustic, doctor, steam still, doctor	5	1½	4	Copper	Yellowish
6	Sample 5 + 7 lb./1,000 bbl. monobenzyl para aminophenol + 0.02 per cent cresylic acid		5	1½	24+	Copper	Copper

TABLE 8—EFFECT OF COMBINATIONS OF LECITHIN WITH OTHER INHIBITORS
All samples contain no TEL.

Sample No.	Gasoline type—	Treatment	Lecithin dosage lb./1,000 bbl.	Sunlight exposure, time for cloud formation (hr.)	
				Without lecithin	With lecithin
1	Straightrun	Doctor	5	½	4
2	Sample 1 + alpha-naphthol (10 lb./1,000 bbl.)		5	½	18+
3	Blended, cracked, and straightrun	Acid, caustic, steam still, and doctor	10	2	5
4	Sample 3 + anthracene (5 lb./1,000 bbl.)		10	4	12
5	Sample 3 + anthracene (10 lb./1,000 bbl.)		10	4	18+

TABLE 9—EFFECT OF LECITHIN ON ACCELERATED GUM TEST (ARMY METHOD)
All samples contain 4 ml. TEL per gallon.

Sample No.	Gasoline type	Accelerated gum, mgs./100 cc.					
		Initial		1 month		2 months	
		Without lecithin	With lecithin*	Without lecithin	With lecithin*	Without lecithin	With lecithin*
1	Straightrun aviation	2	1	3	3	5	1
2	Blended aviation, 60 per cent Sample 1, 40 per cent isooctane	3	1	25	4	45	6
3	Blended aviation, 50 per cent Sample 1, 50 per cent alkylation gasoline	4	4	37	3	40	6

*10 lb./1,000 bbl. lecithin added.

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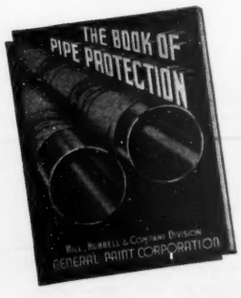

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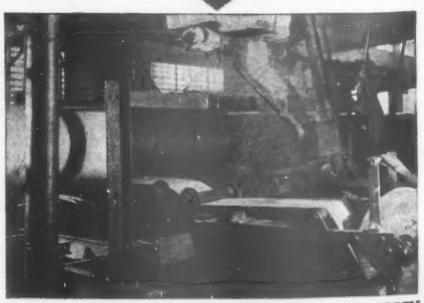

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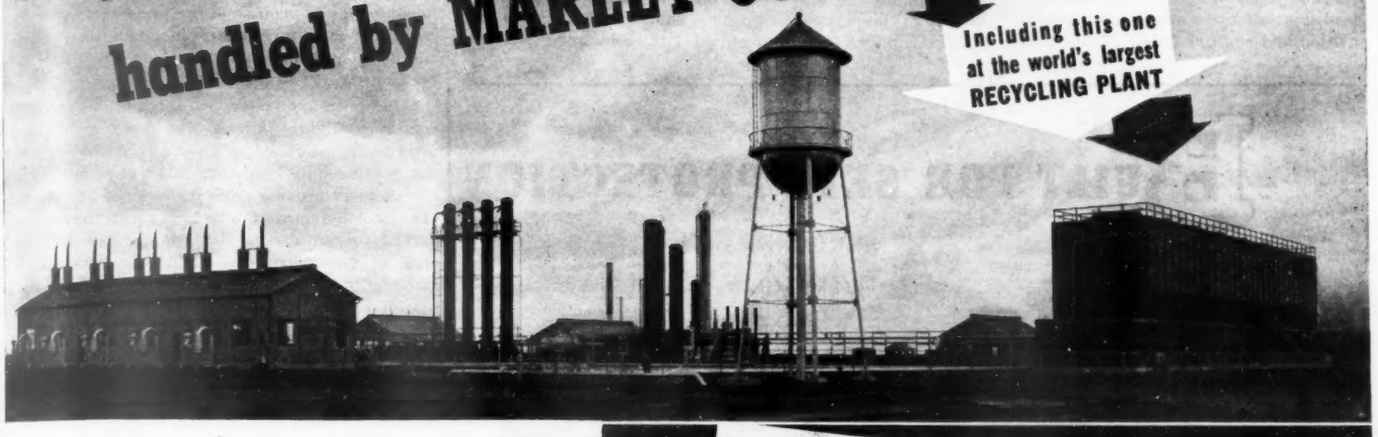

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noted that certain gasolines required the use of an auxiliary agent with lecithin to effect the desired stability. Several antioxidants were tried and it was noted that products such as monobenzyl para aminophenol, alpha-naphthol, catechol and pyrogallol, which in themselves had no stabilizing effect on cloud or deposit formation in sunlight, improved the light-stabilizing properties of lecithin.[18] Certain of these inhibitors, namely, pyrogallol and monobenzyl para aminophenol, resulted in impaired colors after sunlight exposure, while commercial phenol, having a relatively poor gum inhibiting tendency, often bleached the original color. It was found that a combination of these strong gum inhibitors with commercial phenol and lecithin greatly improved the sunlight stability of leaded gasolines from the standpoint of cloud formation and color changes.[5] Table 7 shows typical results obtained on leaded gasoline. Table 8 shows similar results on unleaded gasolines by the use of aromatic ring compounds, such as alpha-naphthol or anthracene.

Effect of lecithin on accelerated gum test.

In addition to the effects previously reported, it was found that lecithin was a valuable additive for the stabilization of the accelerated gum test (Army method) in aviation gasolines. Table 9 shows data covering the stability of typical leaded aviation gasolines and indicates that the accelerated gum content of gasolines which tend to increase on storage may be stabilized by the use of lecithin.

Effect of dark storage on lecithin.

In order to determine whether or not lecithin lost its inhibiting effect on prolonged storage in closed, dark containers, samples of various types of gasolines were stored with and without lecithin both dry and over water, for a period of 1 year and tested for sunlight stability. The results obtained in all cases indicated that lecithin was as effective in the stored samples as it has been initially.

Effect of lecithin in automobile and airplane engines.

After several years of full-scale refinery production of gasolines containing lecithin, examinations of engines using lecithin-treated gasolines did not reveal any deleterious effects, and it appears entirely harmless.

B. Effect on Corrosion of Iron and Galvanized Iron

A separate and distinct function of lecithin was noted during the course of the previously reported work. This was its effect on the prevention of corrosion of iron and galvanized-iron containers by both unleaded and leaded gasolines.

It has been known for years that leaded gasoline was very slightly corrosive to tanks and drums used for its storage.[5] With the rapid increase in the use of highly leaded gasolines in recent years, the problem became more acute since the degree of corrosion appeared to be linear with the amount of TEL present and particularly so since the presence of water aggravated this corrosion. It is common practice to use water as a seal in the bottom of large storage tanks and means of combating this corrosion are of importance.

The reason for this increased corrosion of iron and galvanized iron by leaded gasoline in the presence of water is not definitely known but is indicated to be due to the presence of free bromine or chlorine liberated from the ethylene dibromide and ethylene dichloride present in the TEL fluid to reduce lead deposits in the engine after combustion. These halides probably combine with the water present to form corrosive hydrobromic or hydrochloric acid.

In that lecithin had already been found to prevent deterioration of TEL fluid alone,[3] its effect on the corrosion problem was investigated. Samples of unleaded and leaded gasoline with and without lecithin were stored both dry and over water, to observe the corrosive effect on small strips of carefully cleaned iron and galvanized iron in stoppered glass bottles. After 1 year examination of the strips indicated:

1. In the absence of water, all strips were free of corrosion.

2. In the presence of water and unleaded gasoline, all strips were considerably corroded, particularly that part of the strip which was immersed in the water. The corrosive effect of the water was more pronounced in leaded gasoline.

3. The alkalinity of the water appeared to reduce the corrosion of leaded gasoline, as greatest corrosion was found in the presence of distilled water.

4. The use of lecithin, amounting to 5 to 10 lb. per 1,000 bbl. in leaded gasoline greatly reduced the corrosion of both iron and galvanized iron.

These tests were followed by actual storage in iron and galvanized iron drums and the results were found to agree closely with those reported above. Observation of a large number of storage tanks over a period of years confirmed the fact that leaded gasoline was more corrosive than unleaded gasoline and that its corrosive effect could be remedied by the use of lecithin.

Effect of lecithin on gasoline stored in drums.

Considerable trouble has been encountered by petroleum marketers in preventing the formation of zinc oxide in galvanized-iron drums containing leaded gasoline. This material tends to settle to the bottom of drums on quiescent storage, but is readily dispersed throughout the drum during movement. In aviation gasoline particularly, such a deposit is highly objectionable and commercial air lines go to extreme measures to prevent this material from entering their fuel tanks. Filtra-

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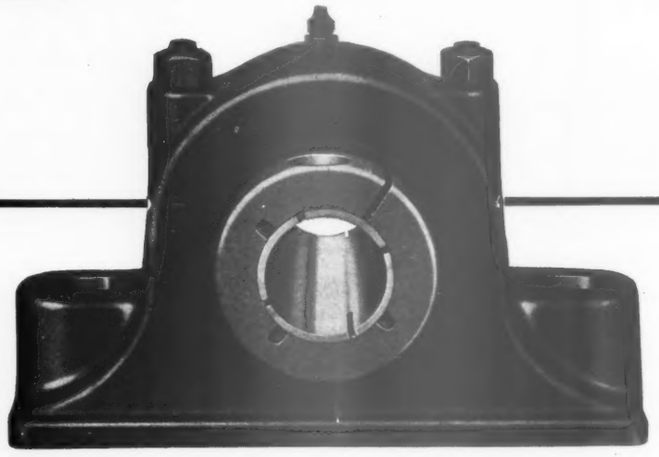

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tion through chamois is sometimes resorted to, but is extremely slow if much zinc oxide is present.

Although specially processed containers can be obtained, this is relatively expensive and should be avoided if a cheaper and dependable gasoline treatment could be found. Lecithin was tried in this connection and found to be extremely effective in eliminating this formation of zinc oxide in the absence of water and materially reducing it in the presence of water when used in dosages of 5 to 15 lb. per 1,000 bbl.

It has also been noted that leaded aviation gasoline particularly was sometimes decolorized or changed from blue to pale green by the action of the lead on the galvanized drums in the presence of water. This decolorization was also found to be practically eliminated by the use of lecithin.

C. Effect on Corrosion of Aluminum

With the adoption of increased tetraethyl lead in aviation gasoline, it developed that certain commercial air lines were experiencing considerable difficulty with the corrosion of aluminum fuel-tank bottoms. The cause was believed to be the condensation of moisture from the air drawn into the tanks as the fuel was consumed. It was found by actual observation that aviation gasolines containing lecithin were relatively free from this corrosion under service conditions and a laboratory investigation was conducted to verify this effect. Available data show that the presence of either TEL fluid or ethylene dibromide causes considerable corrosion of aluminum in the presence of water, and that this corrosion can be largely eliminated by the use of lecithin.

D. Cost of Treatment With Lecithin

Each refiner and gasoline will require a different amount of lecithin to effect the results set forth herein, depending upon the susceptibility of the gasoline to lecithin and upon the desired storage stability. With dosages ranging from 1 to 15 lb. per 1,000 bbl. of gasoline, the cost of lecithin stabilization ranges from $0.0004 to $0.0056 per barrel.

Conclusions

As a result of these investigations, it is concluded that lecithin is effective in improving the quality of gasoline without any detrimental effects and allows the refiner to improve his products along lines demanded by the high octane leaded fuels of today at a minimum of expense. In addition, tankage and drum-maintenance expense is lessened due to reduced corrosion. Furthermore, it furnishes the farmer another outlet for farm products in the petroleum industry.

Acknowledgment

The authors wish to express their thanks to Joseph Eichberg, of the Glidden Co., for his assistance in preparing the section dealing with the structure and physical properties of lecithin.

References

1. Rees, H. V., and Oosterhout, J. C. D., U. S. Pat. 2165651 (1939).
2. Sollman, E. I., U. S. Pat. 1884899 (1932).
3. Oosterhout, J. C. D., U. S. Pat. 2155678 (1939).
4. Hanseatische Muhlenwerke A.G., Brit. Pat. 409353 (1934).
5. Clark, L. A., and Callaway, J. R., U. S. Pat. 2147572 (1939).
6. Bjerregaard, A. P., U. S. Pat. 1761810 (1930).
7. Calcott, W. S., and Parmalee, A. E., U. S. Pat. 1845942 (1932).
8. Burk, R. E., and Lankelma, H. P., U. S. Pat. 2207430 (1940).
9. Rathbun, R. B., U. S. Pat. 2208105 (1940).

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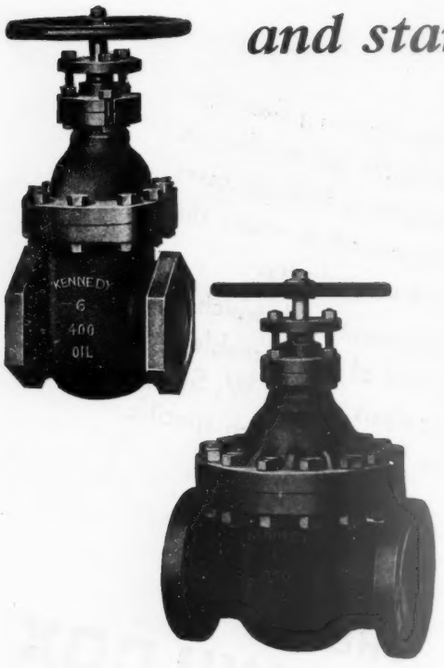

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Oil Recovery by Air Drive in Venango Fields of Pennsylvania

(Continued from Page 175)

principal ones are the oil content of the sand, and the spacing of the wells. Inefficiencies, such as bypassing of air, adversely affect ultimate recoveries. Although the effect of bypassing air is not determinable from the data available, there seems to be a relationship between oil recovery, oil content, and well spacing which may be expressed mathematically.

Data from the more recent developments with close and regular spacing were not available, and oil recoveries per acre may run higher than those indicated in the curves.

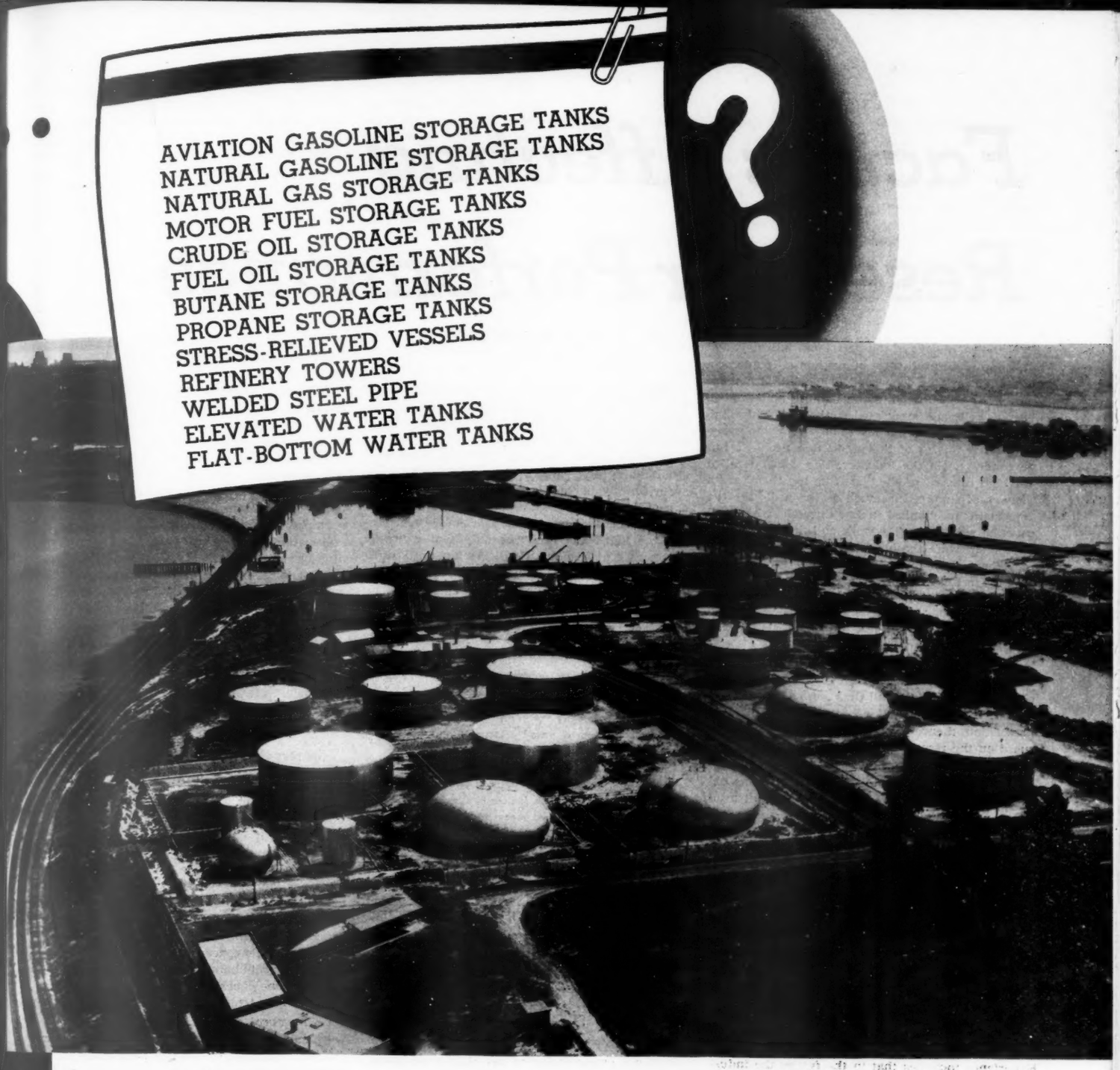
Acknowledgment

The generous assistance of several oil companies that furnished production data gratefully is acknowledged, but their names are withheld so that the leases cannot be identified.

The writers are grateful for the many helpful ideas contributed by H. W. Fuellhart of Pittsburgh, Pa., who would have assisted in the preparation of the paper had his other duties permitted.

Bibliography

1. John I. Moore, "Secondary Recovery of Petroleum. Part 1." Bibliography, State Geol. Survey of Kansas Bull. 25 (1938).
2. John F. Carll, "The Geology of the Oil Regions," Second Geol. Survey of Penn. Report 3, Harrisburg, Pa. (1880).
3. S. H. Cathcart, R. E. Sherill, and L. S. Matteson, "Geology of the Oil and Gas Fields of the Tidioute Quadrangle," Topographical and Geol. Survey of Penn. Bull. 118, Harrisburg, Pa., (1938).
4. C. R. Fettke, "Ten Years' Application of Compressed Air at Hamilton Corners," Trans. Am. Inst. Mining Met. Engrs. (Petroleum Development and Technology) 330 (1927).
5. W. J. Brundred, "Results of Repressuring Depleted Sands in Old Pennsylvania Fields," Natl. Petroleum News 21 (6) 51, and (7) 62 (1929).
6. Carl H. Beal, "The Decline and Ultimate Production of Oil Wells," U. S. Bur. Mines Bull. 177 (1919).
7. Willard W. Cutler, "Estimation of Underground Oil Reserves," U. S. Bur. Mines Bull. 228 (1924).



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Factors Affecting Reservoir Performance

By R. D. WYCKOFF
Gulf Research & Development Co.*

IN the early days of the petroleum industry, and continuing until little more than a decade ago, the engineer was concerned primarily with those problems accompanying the drilling and producing of wells and associated equipment. This limitation in scope was due not to any failure to recognize other phases of the production problem, but to conditions in the industry. The demand called for high rates of production from the then-known sources of supply. Inasmuch as the wells are the important mechanical units through which oil must be withdrawn, the wells and their associated equipment were the bottlenecks on the reservoir, and hence they—not the reservoir—were the targets for technical effort.

The emphasis on rapid development and production, coupled finally with adequate reserve discoveries, led inevitably to a great surplus of wells and a potential output far in excess of current demands. Such a situation resulted, as always, in economic pressure, which forced a change in viewpoint; and thus emphasis naturally shifted from the function of wells to control of production, thence to conservation, and finally focused on the reservoir and its performance.

This resume is presented not for its historical color, but to indicate why, in an industry as old as this, and almost 10 years after the urgent need arose, many engineers are still in disagreement regarding fundamentals. For only with the advent of an era of slower returns did the industry suddenly awaken to the importance of technical studies outside the realm of drilling and production technique, and practical operators to take a more serious interest in what heretofore had been looked upon more or less as academic pastimes. During the past 10 years laboratory research has not been unduly lax, but the necessary coordination of such work with actual operating technique requires time and has not been adequate to provide the maximum rate of advance. Neither laboratory study nor research in the field is alone sufficient to provide solutions to the problems which now are pressing. Experience indicates that in the future the industry must provide better coordination between so-called theoretical and practical production research.

In attempting at this time to outline concisely the factors affecting reservoir performance, and particularly to describe technique capable of determining those factors, we are handicapped by the relatively immature state of development in reservoir technology. Important basic theoretical facts are known, and idealized analyses are possible. What is needed are the qualifying factors obtainable only from experience, which will permit the application of theory to practice or, rather, which will provide assurance to all concerned that reservoir performance is determined by, and does follow, definite physical laws, the fundamentals and many details of which already are known.

We are well aware that the technologist's apparently insatiable appetite for more and more detailed information from the field is almost equalled by the operator's horror at its cost and time consumption. It has been said facetiously, but with some justification, that to run into a well all of the data-procuring "gadgets" now available would leave neither time nor funds for drilling and producing. However, as production engineers have been willing gradually to shoulder some of the technologic stigma, some of these data have been secured and their value proved. At present almost every conceivable measurement is specified as necessary or desirable and, because of the dearth of experience, it is impossible at this time properly to cull the items and prescribe only that which is pertinent. This condition will remain until sufficient experience has accumulated to permit specification of the relevant minimum.

It is hoped that this rather lengthy introduction may serve adequately to emphasize that in the discussion which follows we are not attempting to write specifications, but merely to indicate the general type of field data needed and the possible scope of application.

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A. P. I.

Factors affecting reservoir performance are considered from a broad viewpoint and in conjunction with a review of general reservoir mechanics. The interrelation of these phases of the production problem thereby is stressed. Methods of determining such factors are included only when it is considered necessary to clarify the discussion, and for this purpose only.

Paper was presented before Division of Production at annual meeting of the American Petroleum Institute, Chicago, November 11-15, 1940.

Classification of Factors Affecting Reservoir Performance

It is not exaggeration to say that every detail regarding a petroleum reservoir and its fluid content, as well as the manner in which it is handled, is a factor affecting the performance of the reservoir. Moreover, these factors are so interrelated that it is impossible to consider them one by one and evaluate properly their influence upon the overall behavior of the reservoir. Under a given set of circumstances certain factors predominate and practically control the performance, whereas under other conditions those factors may play only a minor role. It is the complex interdependence which makes it impossible in general to discuss details of reservoir performance, without first stating explicitly the exact circumstances under which the various factors are involved. It is the failure to consider the whole picture, or the inability to present it in its entirety due to the lack of essential information, that leads to misinterpretation or disagreement regarding the behavior of a reservoir or its producing wells. Certainly the fundamental physical facts are now sufficiently known adequately to cover the essentials of most production problems, if the knowledge of field conditions were defined sufficiently to permit analysis. Our most urgent need at present is more definite knowledge concerning conditions within any reservoir so that the primary factors may be isolated and the performance analyzed. In the situation usually presented we are reminded of Buckles's statement in his History of Civilization in England: "We live in that predicament that our facts have outstripped our knowledge and now encumber its march."

It is difficult, in view of this interdependence, properly to classify the various factors in an attempt to segregate them in the order of their importance, and thus simplify discussion. The only segregation that seems justified is the very broad division:

1. Factors inherent in the reservoir, and over which little or no control is possible.
2. Factors influenced by the exploitation program, i. e., under partial or complete control.

Thus, merely for convenience, we shall consider first the more or less fixed reservoir characteristics, and later those factors influenced by operating technique—bearing in mind that the latter should be determined by the former, and hence in practice the picture must be viewed in its entirety.

Reservoir Factors Affecting Production Performance

Type of Reservoir

Any reservoir presents certain characteristics with which it was endowed originally, and over which we have very little or no control. Each of these has some influence over the reservoir performance, and indeed some of these may so far overshadow all others as to dictate the technique of production. The type of reservoir is, therefore, a matter for first consideration; and by "type" is meant details concerning:

1. Structural characteristics.
2. Pay-zone characteristics.
3. Fluid content.

1. *Structural characteristics.*—In general, reservoirs may be any one or a combination of domal, faulted, lenticular, or stratigraphic traps. In so far as the dynamic performance of such reservoirs is concerned, the particular type merely determines whether regional flow is symmetrical as in a uniformly developed domal or lenticular type, or one-sided as in many stratigraphic or faulted traps. However, the importance of such information in the planning of an efficient development program is too obvious to require elaboration.

Even more important than the structural type is the amount of closure involved, or in other words, the steepness of the dip within the reservoir. For, as will be discussed later, the efficiency of production directly is related to this structural factor, provided other conditions permit its use advantageously.

2. *Pay-zone characteristics.*—The pay-zone characteristics are evidently a primary factor. In general, pay horizons are either sand or limestone and, as far as production performance is concerned, any formation having porosity of the type found in sands will have similar performance characteristics. Thus, as regards the production mechanism, certain types of porous limestones may be classed with sands. likewise, highly fractured lime-

stones may, on a large scale, simulate certain characteristics of sand reservoirs. However, in general, fractured or cavernous pay zones require special consideration, depending on the size and lateral continuity of such fractures or cavernous features. Evidently the performance of such a reservoir will be characterized by very high erratically distributed well potentials, rapid equalization of pressures, and, in general, will perform as a unit with very low internal resistance to flow. Principles regarding the internal mechanism characteristics of sand pays[1] will not apply, and it is particularly advantageous that operating technique be designed to take full advantage of structural configuration whereby gas cap or natural water drive may be utilized efficiently, for these highly permeable reservoirs are inherently amenable to such operation.

Multiple pay horizons: It is evident that if several pay horizons exist with sufficient vertical separation, they should be considered as separate reservoirs. Multiple pay horizons, as here considered, refer to a reservoir in which wide variations in sand characteristics occur within a single pay zone. Inasmuch as each portion of the pay, defined by certain porosity and permeability values, will behave in production in accordance with these individual properties, uniformity of the pay zone is an important factor in reservoir performance, requiring special consideration.

Moreover, inasmuch as these variations as observed in individual wells may represent either sand lenses in a relatively impermeable shale matrix or shale lenses in a sand matrix, it is important to determine which case characterizes the reservoir. For evidently, if the pay comprises sand lenses, for maximum recovery the well density used must be such as to provide penetration of individual lenses. On the other hand, shale lenses in a sand matrix will not break up seriously the continuity of the pay zone, and well density becomes of secondary importance. In fact, if water is involved, such lenses may be advantageous in providing impermeable barriers at which plug-back operations may be aimed and water coning in individual wells effectively controlled, e.g., the East Texas field.

3. *Fluid content of the reservoir.*—The intelligent handling of any reservoir presupposes a detailed knowledge of the fluids contained therein. This involves not only information regarding the type of gas and oil, but the degree of gas saturation in the oil, and data regarding the release of gas from the oil as pressure is reduced. If the oil is saturated with gas, a free gas cap probably is present, and in this case the size of the gas cap and the boundaries of the gas-oil contact should be known. Similarly, if bottom or edge water is present, a knowledge of the oil-water boundary and its mobility (rate of encroachment when reservoir pressure declines) is as important as information regarding the gas cap, because the ultimate recovery efficiency may depend upon proper utilization of the natural water drive.

In recent years a new type of reservoir has become of major importance. This is the so-called single-phase or gas-distillate type. Proper handling of such reservoirs definitely requires detailed knowledge of the volumetric and phase behavior of the reservoir gas, and is obtainable only by careful sampling and laboratory analysis.

The Determination of Reservoir Factors Affecting Production Performance

The foregoing outline indicates that every available scrap of information regarding the reservoir is of value to the engineer in analyzing reservoir performance and planning reservoir exploitation. It is evident also that the obstacles in the way of realizing such complete knowledge in actual practice are numerous, and some are as yet insurmountable. However, some of these data are obtainable by special devices; others by careful analysis of the performance of the reservoir under actual operation.

Core analysis.

Although the structural information available during the initial stages of development may be meager, exploratory development at an early stage could provide the essential facts. Pay-zone characteristics may be obtained from the first few wells, provided they are adequately (continuously) cored through the pay zone, and complete core analyses are made in a reasonable number of key wells. Special logging devices (i. e., electrical) run in all wells, through correlation, will serve to extend the actual physical analyses* from key wells to adjacent areas.

Thus, careful coring and complete core analysis appear to be essential for any intelligent development. Moreover, it seems to hold the only hope whereby pay-zone characteristics can be determined. And, incidentally, experience seems to indicate that it is a profitable procedure, even if used only as a guide in completing wells, not to mention the value of the data at a later date in planning development and operating procedure.

Without going into the question here, the determination of reserves is at once one of the most important and evasive problems confronting the industry—important not only in economic considerations, but in the direct evaluation of the influence of various factors here discussed on the performance of a reservoir. And on cursory consideration it might seem that the process of direct sampling of the reservoir by coring and subsequent careful analysis in the laboratory provides an immediate solution not only to questions regarding porosity, permeabilty, and other physical properties of the pay, but to questions regarding the fluid content of the pay in situ. In regard to the physical properties of the pay, the information is ascertained indeed directly and adequately. In the case of the fluid content of the cores, the data are less certain, for the sample analyzed is not one under reservoir conditions, but one which has been exposed to modification, both by contamination due to infiltrating drilling fluid, and subsequent reduction in pressure analogous to a production process carried to depletion. Therefore, in practice the original fluid contents are inferred by suitable statistical information, coupled with the knowledge of the residual fluids observed in the core sample. Various techniques, not describable here, are used to convert the observed values to those representative when the core was undisturbed in the reservoir. Recently special core barrels[2,3] have been designed with the view to bring core samples to the surface in pressure-tight chambers, so that the reservoir pressures and fluids are retained. However, neither of these yet offers a solution to the problems of contamination by infiltration of drilling fluid.

We have indicated the difficulties involved in core analysis because of the importance of the method, for it seems to offer the only direct solution to the problem of determining reserves and depletion in small areas. However, it will require very excellent technique to obtain depletion figures with sufficient accuracy to lead to significant conclusions regarding the influence of various factors in reservoir performance, which is now the subject of endless controversy. However, encouraging results have been reported, and improvement with added experience and application is certain, and should be expedited.

*The use of electrical logs alone to determine the fluid content does not appear reliable. Although valuable in a qualitative sense, there appears to be but little hope that it will ever provide quantitative information, and hence will not supplant core analysis.

Bottom-hole sampling and pressure measurements.

In addition to the determination of the fluid content of the reservoir by core sampling, it is also important to analyze bottom-hole fluid samples obtained under the existing pressure. From such samples may be obtained information concerning the gas content of the oil and its saturation values under declining pressure, which are absolutely essential to a proper understanding of reservoir performance. Moreover, in a gas-drive field, a comparison of the reservoir gas-oil ratio with the ratio produced provides a direct measure of current operating efficiency. In passing it might be mentioned also that a careful analysis of gas from an apparently single-phase reservoir, coupled with present-day knowledge of phase equilibria in hydrocarbon mixtures, may serve to indicate saturation conditions pointing to the existence of an oil zone on the flanks of the structure. Needless to say these structures also require bottom-hole pressure measurements which, together with bottom-hole samples, should be a routine procedure in discovery wells; but further consideration of these factors will be given later.

Factors Influenced by Exploitation Program

Due to the complex interrelation already mentioned, it is impossible to draw a sharp line of demarcation between factors rigidly fixed by reservoir conditions and those under complete or partial control by the operator. An attempt has been made to do so in order to simplify discussion. Having considered briefly what we have called "reservoir factors," a similar outline of "controlled factors" will be undertaken. And here the problem becomes more complex, because the interdependence of all factors pervades the entire picture.

The function of wells.

Certain general statements regarding the wells themselves may be made without much qualification. The function of wells in a petroleum reservoir has been defined concisely by Moore[1] as "the important mechanical units through which oil (or gas) must be withdrawn, and which provide information necessary for the efficient control of the reservoir." It is a fact that two conditions, and these alone, permit the production of oil from wells:[4] (1) The oil must be displaced from the reservoir by some other fluid, either gas or water; and, (2) a pressure gradient must be set up between the portion of the reservoir yielding oil and the well bore from which it is withdrawn. Hence unless a well is introducing gas or water into the reservoir, as in water flooding or repressuring, its function only can be to reduce the pressure at the well bore, and thus induce flow into it. Except in so far as the equipment in the well serves to affect its bottom-hole pressure, this equipment is not a factor in reservoir performance. Moreover, the fluids—gas, oil, and water—produced by the well are determined completely by reservoir conditions and the pressure maintained at the well bore, and are not affected otherwise by the well's equipment. Thus the bottom-hole pressure in a well is the primary factor, not the well, although its equipment is instrumental in the control of pressure.

Location of wells in the reservoir.

The location of the bore hole in a reservoir is (ostensibly) under the operator's control, and both its location on structure and position vertically within the pay zone are important factors. However, the relation of well location on structure and reservoir performance involves other factors, which will be considered later.

It is evident that in a zone of multiple pay horizons the vertical position of the open bore hole with respect to the individual pays markedly will affect performance. Thus completion below a gas zone minimizes gas production, or plugging back may eliminate bottom water. Such operations may be handled most effectively if complete core analyses

are available; and the principles involved, and which apply to the multitude of similar problems, need no mention here.

Diameter of wells.

The diameter of a well bore as a factor in reservor performance long has been debated. Theory indicates that, for example, increasing the diameter of a 6-in. bore to 12 in. should increase the potential approximately 10 per cent, and we, therefore, conclude that well diameter for all practical purposes is an unimportant factor. And as concerns the well diameter, per se, there is no room for argument. On the other hand, field experience maintains that well diameter has a very substantial influence, although data are erratic and inconclusive. The erraticness of the field data and the seeming conflict with theory all may be harmonized by merely looking for the new factor. Thus it will be found that, whereas well diameter actually may have an appreciable effect, it is an indirect one which would disappear—i. e., conform with theory—if all wells could be completed perfectly. However, the influence of the size of the hole upon the efficacy with which the mechanical completion job may be made is evidently the real problem, not the diameter itself. A good completion, i.e., one in which the sand face or screen liner is left clean and free from obstructions, is clearly important, but the effect of a poor completion is that of a choke, and relates to operating pressure and well equipment rather than to the reservoir. Thus we return to the original statement that well diameter, per se, is a negligible factor.

Discussion of reservoir mechanics.

Water drive.—That the production of oil from a reservoir requires its replacement in the rock by either gas or water already has been mentioned. Neglecting for the present any injected fluids and considering only natural processes, it is clear that, in the case of displacement by water, this can be accomplished only by the bodily encroachment of water from regions adjacent to the oil reservoir. To the extent that the mobility of the water drive may be adequate and it is intended to use this natural drive, wells should be so located on the structure as to permit the most efficient utilization of this water drive. When the flanks of a structure have relatively steep dips, so that the gravity gradient due to the difference in density between oil and water may be comparable to or exceed the regional dynamic pressure gradients in the reservoir, then a well-defined oil-water contact and ideal conditions are indicated. Wells then should be positioned at strategic upflank locations in sufficient numbers to provide the proper production rate with a smooth regional pressure distribution.

However, this ideal well-defined oil-water contact with uniform encroachment requires unusual conditions. Inasmuch as the density difference between the oil and water is not likely to exceed 0.2, the gravity gradient tending to maintain a uniform contact amounts to about 0.1-lb. per ft. elevation between the two fluids, and on a structural slope of 200 ft. per mile the maximum available gravity gradient amounts to only 20 lb. per mile. This means that, under the assumed conditions, water might advance upstructure through a highly permeable horizon one mile ahead of the main body before gravitational force could balance the dynamic gradient and suppress the fingering. Obviously the effectiveness of gravitational forces in maintaining a uniform level of encroachment throughout an oil zone having horizons of variable permeability is very minor, unless the regional dynamic pressure gradients imposed on the reservoir are correspondingly small. However, some limestone reservoirs do conform to these conditions, and for all practical purposes behave like a tank in which bottom water replaces oil withdrawn from the top, and wells showing water soon reach the abandonment stage.

Evidently, then, the normal performance of a water-drive reservoir partakes more of the behavior of a horizontal pay zone with edge water advancing through the various strata at rates determined by their relative permeability, i. e., rates of oil withdrawal through these horizons. Yet this situation does not alter the picture as far as proper well locations are concerned, for there appears to be no particular merit in distributing wells uniformly over the entire areal extent of the flanks of the reservoir, except as economic considerations and expediency may dictate. A more pertinent factor than the well location in such cases is a thorough knowledge of the pay section, so that any well-defined horizons of high permeability might be shut off when excessive water production via these channels reaches the well.

In fact, in considering factors of importance in any water-driven field, it may be worthwhile to consider seriously the modern trends in water-flooding operations, for in principle there is no difference. In such secondary-recovery programs the one-time important questions concerning flooding patterns and well-spacing problems have been relegated to their proper economic criteria,[1] whereas the purely technical reservoir problems now involve mainly careful core analysis, attention to individual horizons within the pay zone, and control of operating pressures. Moreover, it may be timely here to point out that, in view of the nature of water drives in most reservoirs due to only partial effectiveness of gravitational forces, the prevailing mechanism of production will be that outlined by Moore,[2] and the recovery efficiency will be governed by these principles of water-oil or even three-phase fluid flow rather than the piston-like action of a body of water as in the ideal case.

Gas drive.—When the oil produced from a reservoir is replaced by gas, the mechanism commonly is termed a "gas drive." This displacement may be accomplished through expansion of the gas cap incident to the decline in reservoir pressure, as well as by gas which always comes out of solution in the oil zone when the reservoir pressure

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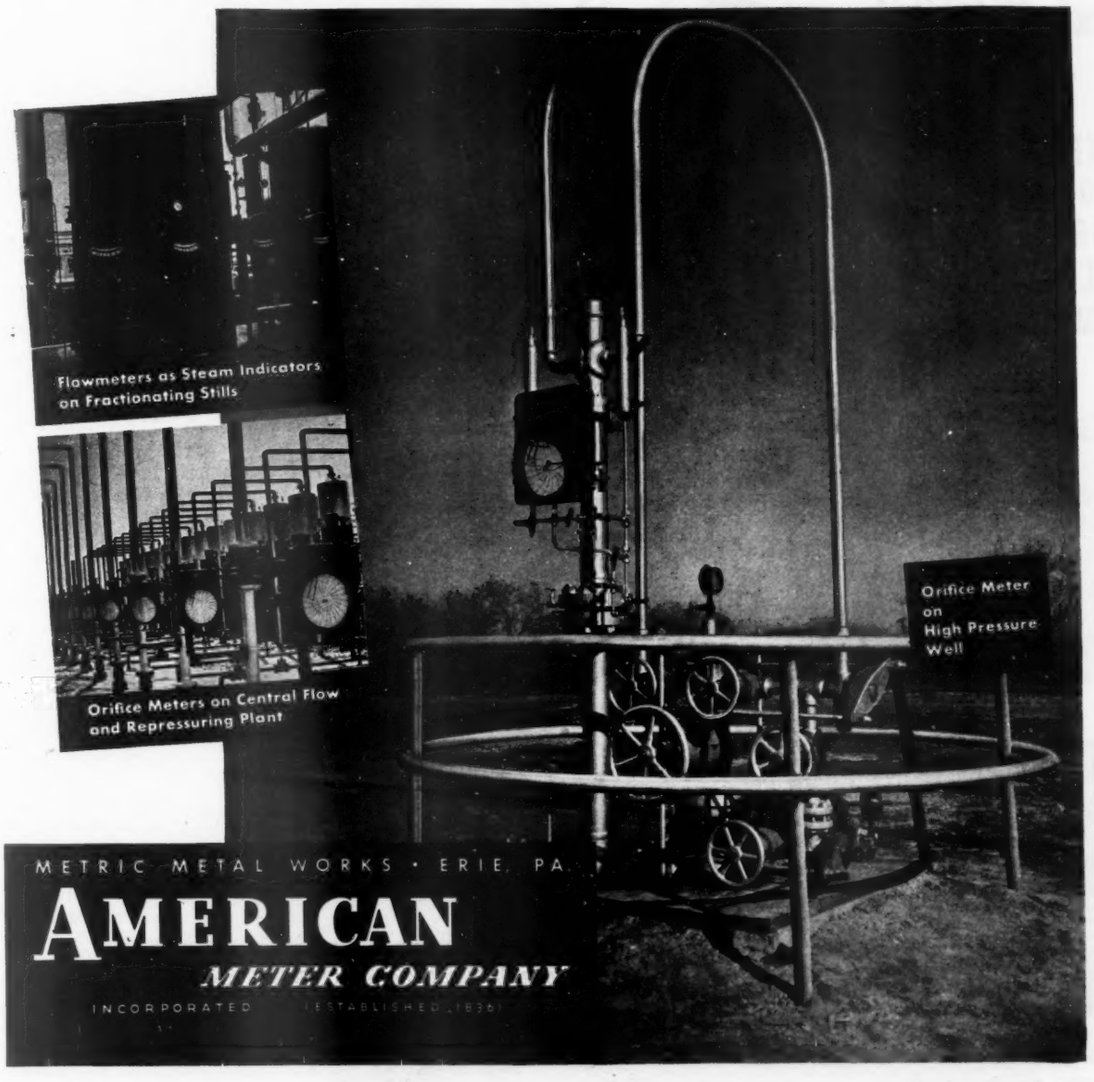
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drops below the saturation value. Although a complete discussion of this is out of place here, as was the case with water drive, it is necessary to include some details in order properly to define the problem. For, because of expected differences in efficiencies, we must distinguish between two types of gas drive, which for identification purposes will be termed:

1. Internal gas drive; or, in secondary recovery, recycling.

2. Gas-cap expansion; or, in secondary recovery, repressuring.

1. *Internal gas drive.*—An internal gas-driven reservoir in the sense used here may be idealized as a horizontal pay zone of very limited vertical dimensions, so that gas segregation or gas-cap formation is not involved, and the drive derives primarily from the displacement of oil by gas coming out of solution. Production from such a reservoir follows the mechanism which has been delineated by laboratory studies,[1] and is characterized by relatively low recoveries in comparison with water drives. This is due primarily to the very low viscosity of gas compared to oil, and the resultant exceedingly high gas-oil ratios, even at relatively low values of oil displacement.

If these laboratory studies of "mixture" flow have contributed nothing else, they definitely have shown the futility of attempting to obtain really high recovery efficiency by internal gas drive alone. This by no means implies that in many cases in which reservoir conditions—particularly structural conditions—permit of no alternative, this method of natural recovery, perhaps followed or accompanied by recycling, is not proper. But the mere fact that subsequent recycling of gas (i. e., internal gas drive) is economically feasible indicates the relatively low efficiency of the primary recovery phase, and the large volumes of gas involved in effective recycling may be anticipated from the characteristics of multi-phase flow.

2. *Gas-cap expansion.*—By gas-cap expansion is meant that type of mechanism in which, in its idealized form (analogous to the ideal water drive), the reservoir behaves like a tank in which expanding or injected gas in the top replaces oil withdrawn from the bottom. However, whereas in the case of water drive a density difference of only 0.2 is available to maintain a distinct water horizon, in the case of gas and oil a density difference of approximately 0.8 is available to permit more effective functioning of gravitational force. Thus the tendency for gas and oil to segregate into distinct bodies is some four times greater than in the case of oil and water, and, for a given steepness of structure and regional dynamic gradient, there is that much less tendency for the "gas piston" to degenerate into an internal gas drive. That such operation is actually possible and has been achieved in many cases, especially in reservoirs having pronounced structure or high permeability pay, is evidenced by direct observation of the formation or growth of gas caps.

The relative recovery efficiency of a gas-cap drive has not been determined, and is one of the problems that needs field study. However, it seems reasonable that it might equal that of a water drive, and most certainly does exceed that of an internal gas drive.

What has been said about the gas cap, presumed to occupy the highest structural position in the reservoir, also applies—but obviously to a lesser extent—in flat-lying pays having sufficient thickness to permit segregation. If the point of withdrawal is from the bottom of the pay with the upper portion sealed off, then, to the extent that downward gas coning into the well is controllable, the more efficient gas-cap mechanism is operating. Here again field data are not now available conclusively to determine the actual recovery efficiency.

Secondary-recovery gas injection.—In regard to secondary-recovery methods using gas injection as the impelling fluid it is evident that the aforementioned two types apply. In the one case, when the gas is injected in such manner as to obtain only the effect of "sweeping out" the oil by virtue of increased gas flow through the partly saturated oil zone, the term recycling seems appropriate, leaving repressuring or pressure maintenance to describe the methods in which the primary aim is the displacement process involving the segregation of large bodies of gas in the reservoir. It is recognized, of course, that in practice both effects are produced; but certainly there will be one which dominates. And again it should be mentioned that the laboratory studies already referred to indicate conclusively that the aim should be the utilization of segregated bodies of gas as the dominant drive.

In view of these simple principles governing reservoir mechanics—and they are not new—it seems incredible that there could exist any lack of agreements regarding operating plans or the factors involved. Undoubtedly any apparent lack of agreement arises not from purely technical questions, but is the result of conflicting interests dictated by economic, statutory, and other factors quite outside the technologic realm and frequently prejudicial to an orderly exploitation program, even under non-competitive circumstances. In any practical case it usually is necessary to consider a multiplicity of unalterable circumstances which govern the mode of operation. And therein lies the difficulty in attempting to outline physical factors which alone determine reservoir performance. In other words, although the normal influence of such factors follows definite physical laws, the extent to which they may be permitted to operate governs their actual effect.

With this qualification and the brief outline of reservoir mechanisms already given, the physical factors involved may be discussed.

Factors involved in water, gas, or combination drive.

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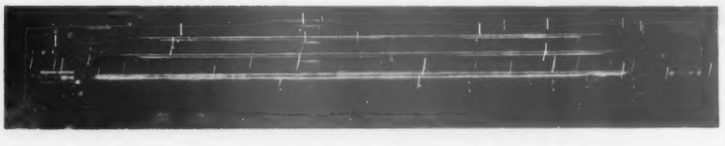

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or currently controlling the operation of a reservoir, to know the energy source responsible for its operation. In regard to the two types of available drives, a fundamental difference affecting their performance characteristics may be mentioned:

1. In a natural gas drive the only available energy is that stored in the beginning, and is represented by the pressure at which the total gas content of the reservoir existed originally. The dissipation of this energy follows well-known laws; and, inasmuch as no new energy is added, it follows that:

The pressure-vs.-production characteristic will be consistent throughout the life of the field; i.e., the total pressure decline at any time directly is related to the accumulated production (gas and oil), as is also the rate of decline vs. production rate.

2. In a water drive new energy is being supplied continuously at a rate determined by the characteristics of the adjacent water reservoir and the pressure gradients induced in it. In fact, the performance of the oil reservoir reflects the characteristics of the water reservoir, and primarily is determined by the latter—except in so far as the operating pressures are concerned. The result is that:

In a water-driven field the reservoir pressure is not related directly to cumulative production, but involves production rates; and, in the case of an "elastic" drive, their past history. In general, therefore, a water-driven reservoir is characterized by a direct relation between pressure drop and production rate, not cumulative production.

The use of these fundamental characteristics in the determination of the type of drive on which to predicate proper handling may be clarified by a brief discussion. At the same time certain difficult problems in this connection will be emphasized.

Gas drive.—In any type of gas drive the reservoir pressure must exhibit a declining characteristic, for only then can any energy be extracted from either free or dissolved gas. It is evident also that in a purely gas mechanism there can be no recovery of reservoir pressure due to shutdown or curtailment of the output. Thus the combination of these two criteria provides ample evidence of the reservoir mechanism, and failure of a reservoir to gain in pressure during a shutdown is conclusive evidence of inappreciable water encroachment.

Here, however, it is pertinent to emphasize that pressure data must be analyzed completely and carefully; for otherwise, as an example, purely local equalizations of pressure may be interpreted as a rise in average reservoir pressure, and false conclusions derived.

Water drive.—In a complete water drive the fluids withdrawn are replaced by an equal volume of water encroaching the reservoir. Also, it has been mentioned that the performance of the oil reservoir reflects primarily that of the water reservoir. If the latter can be considered as a simple steady-state artesian drive, such that the flow into the oil zone is directly proportional to the pressure difference between the oil and water zones, then the pressure in the oil reservoir at any time will be proportional to the production rate, maintaining a constant value as long as the withdrawal rate is constant. And it will be clear that pressure-vs.-production-rate data provide adequate evidence of this mechanism.

However, that this simplicity does not always characterize the performance of a water reservoir was amply demonstrated by a rather unique combination of circumstances, which permitted a clear-cut analysis of the mechanism of the extensive Woodbine water reservoir adjacent to the East Texas field. Here a complete water drive is associated with a slow, but continuously declining, pressure characteristic. Diagnosis of the true performance of this field involved several factors, and of prime importance was the known undersaturation of the oil learned from careful analysis of the reservoir fluid. Knowing that no gas could come out of solution at the then-existing reservoir pressures, the presence of a complete water drive was a necessary conclusion. And from the production-vs.-pressure-decline characteristics, as well as the reaction to shutdown of the field, the now well-known elastic-fluid theory of the Woodbine water zone was derived.

This case has been reviewed in some detail as illustrative of the fact that pressure-decline data alone may not be diagnostic. It clearly indicates the ambiguity which may arise in attempting to distinguish between a water-driven reservoir and one which is a combination water and gas drive. In fact, in the absence of other essential criteria, the elastic behavior of the water drive of the Woodbine type—which actually simulates a gas drive—might be mistaken for the latter alone, and the extent of the oil and gas reserves in the reservoir grossly overestimated. Thus is illustrated the necessity of having not only pressure-decline data and especially accurate information regarding the reservoir's reaction to changes in production rate or shutdown, but also accurate knowledge of the gas-saturation characteristics of the reservoir oil. This is especially true when a combination gas-and-water drive exists and it is desired to ascertain the relative importance of the two types; for at best this is a very difficult problem, the solution of which may remain ambiguous because of the absence of a single clue.

Some may question the importance of such determinations regarding the reservoir mechanism. It hardly seems necessary, however, to point out that upon such knowledge the entire exploitation and operating program depends. In so far as extraneous factors permit of any intelligent planning, then it is the obvious aim so to develop and operate a field that a maximum recovery at a

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minimum cost is obtained, and that there shall be no secondary-recovery phase involving new expenditures that might have been eliminated had the proper perspective been possible at an earlier stage. Thus if it is possible early in the development to realize that a complete natural water drive is available, an attempt properly might be made to make full use of it, both in the location of producing wells and in their operations. Likewise, a knowledge of the type of gas drive or combination gas-and-water drive will determine in practically every detail the engineering problems incident to development and production. Moreover, even though circumstances do not permit development based upon consideration of the reservoir as a whole, there remain many of those incidental problems — individual well or lease problems if you like—the solution of which depends upon a thorough knowledge of the reservoir mechanism.

Wells as factors in reservoir performance.

The function of wells and some details regarding their completion have been mentioned earlier. In regard to the influence of the areal distribution of wells in a reservoir, Moore[1] ably has stated: "In every field there is a zone into which oil naturally migrates under the force of an efficient gas or water drive, and it is within this zone that wells assume their greatest importance. In locating and completing wells, the most important consideration should be the control of the displacement of the oil by gas or water. The number of wells is of minor importance, except in so far as a sufficient number must be drilled to provide for adequate control."

This summary of principles requires no further elaboration, for their application is but a matter of detail involving the specific conditions present in individual reservoirs. Their aim is not only conservation of the driving energy but, if possible, to produce from the oil zone without displacing it bodily within the reservoir from its normal environment into new areas where intermixture, particularly in a dry-gas zone, will result in irrecoverable absorption.

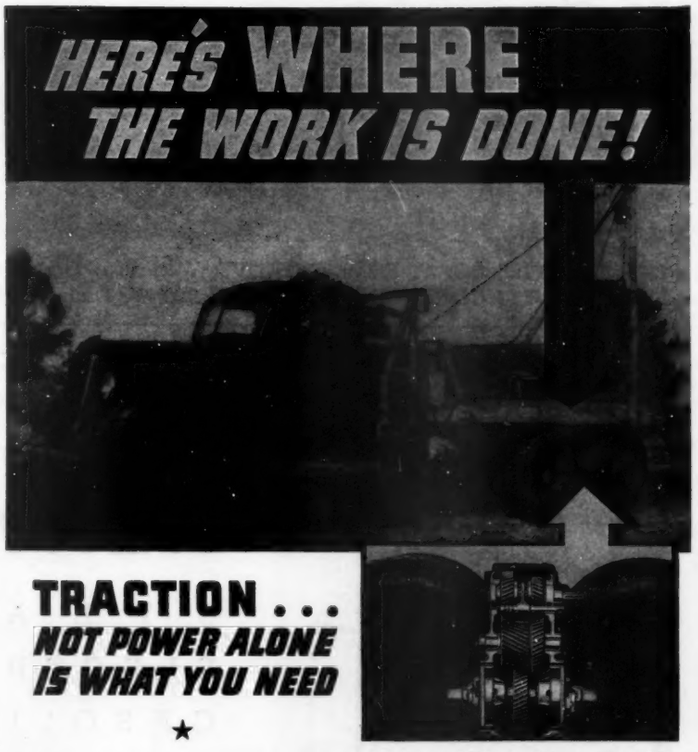
However, the statement that "the number of wells is of minor importance . . . except that they provide for adequate control" is deserving of further consideration, as it is one of the most controversial questions in the industry. And I will not hesitate to say here that opponents of the above thesis contend that it is based upon wishful thinking—an expedient theory—rather than one based on facts.

Well spacing.

If well density is an important factor in reservoir performance beyond its influence in providing adequate control, it must involve an effect upon ultimate recovery. This predicates a physical limit to the radius of drainage around a well. And yet, 10 years of intensive search for some physical phenomena in the production mechanism leading to a limited radius of drainage has failed to disclose its existence. And this refers not to water or gas-cap drives, but to the type which conceivably might exhibit such a characteristic, viz., an internal gas drive. This is laboratory experience, yet it is substantiated by direct observations in the field, where regional migration over very large areas within a reservoir is an established fact, derived from careful study of reservoir-pressure data available in recent years. It is on such data that the concept of an "unlimited" drainage radius of a well is based. However, the term "unlimited" requires qualification; for even the most academically-minded theorist has no intention that it be carried to impractical extremes, as a literal interpretation would imply. Even he has stated that "within reasonable limits the spacing of wells is an immaterial factor in the recovery of oil." We shall be specific here and define what is meant by "reasonable," in an attempt to bring the contending schools of thought onto common ground for discussion. If this can be done, it is likely that the argument at least will be more fruitful, and even may result in some semblance of agreement.

Considering only the pertinent type of mechanism, the internal gas drive, first it is important to distinguish between purely physical phenomena and practicable attainments. The controversial theory is based on the necessary assumption that a well be operated until the last dribble of oil has been taken from it, i.e., it presupposes that the reservoir pressure everywhere has attained an irreducible minimum. This is, of course, a practical impossibility; for long before that stage could be reached, abandonment would have been forced by cost considerations. Thus economic considerations set a time limit on the operation of a well, thereby determining the pressure distribution, and hence the depletion of the reservoir in the area around a well at the time of abandonment. For this reason we must consider not purely physical limits of depletion, but economically determined depletion. Thus indeed we may assume that, in this sense (a nonuniform distribution of depletion) a limited radius of drainage does exist, but it is one determined by economic considerations alone.

Let us then consider the well-spacing problem as a purely economic one, and for the moment forget the controversial physical aspects on the basis of which the problem seems to evaporate. From economic considerations it is possible to set a minimum production rate below which it is impractical to operate a well. Then, together with other data—including pressure decline and essentially the overall pay-zone permeability (derived from productive indices of wells if preferred)—an optimum figure for well spacing may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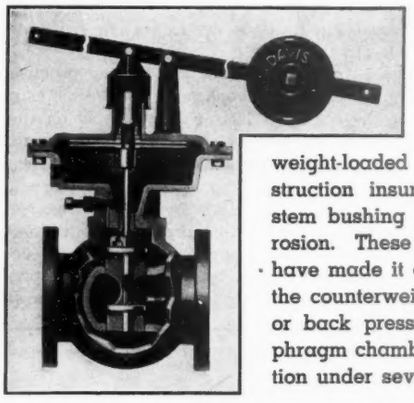

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This valve combines the sensitivity of a weight-loaded regulator with the patented weatherproof construction insuring reliable trouble-free service. Valve stem, stem bushing and lever pins are stainless steel to resist corrosion. These features together with its rugged construction have made it a favorite in all the fields. Merely by reversing the counterweight, No. 330 W is convertible for either vacuum or back pressure. Built-in bypass (for throttling flow to diaphragm chamber) steadies the valve action and prevents vibration under severe operating conditions.

No. 330 W

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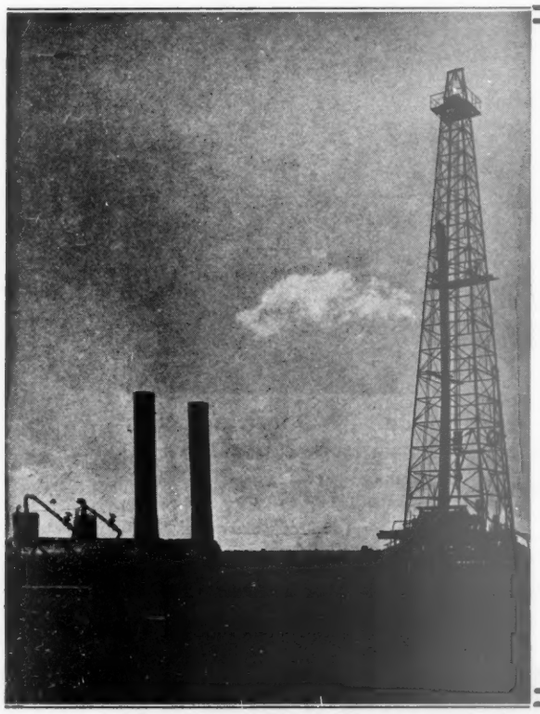

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be derived. This optimum merely means that, under the economic conditions prevailing, a well density either greater or less than the optimum will result in a decreased economic recovery; and, in the last analysis, in any practical operating system it must be found that economic efficiency is synonymous with efficiency in any terms it may be desired to clothe it.

Although, on the basis of the known production phenomena already referred to, the spacing problem is so elusive as actually to appear nonexistent—and certainly impossible to evaluate—the economic factor provides a real criterion and a direct solution. Optimum well-density figures derived on this basis provide spacings sufficiently close to qualify adequately the term "reasonable," and to eliminate any physical questions regarding the ability of the wells to recover the oil. Thus an economically derived well spacing provides a solution to the problem and adequately encompasses the ideas of conservation, which admittedly must be a primary consideration.

Finally, it is of interest to note that already in secondary-recovery water-flooding operations the well-spacing problem, once an outstanding physical question, has been relegated to the economic phase. For apparently it has been found that an economically sound spacing program provides a density of wells sufficient to eliminate any serious questions regarding efficiency in recovery.

For purposes of completeness it seems necessary to make the trite qualification that if from adequate data regarding reservoir factors it is known that the reservoir comprises discrete nonconnected lenses, then evidently the number of wells should be sufficient to provide penetration of each lens. However, it appears from the reliable data obtained from numerous reservoirs in recent years that alteration of an economically derived spacing program seldom would be necessary.

Summary

Any consideration of factors affecting reservoir performance requires first a definite commitment concerning the basic principles underlying the performance without which elaboration upon details is meaningless. Thus the foregoing discussion dwells at some length upon this phase of the question. The concepts of reservoir mechanisms which have been outlined represent, in the writer's opinion, the accepted modern views. On this foundation the more important factors involved, together with some related details, have been reviewed. Other factors not considered here, and their role in the performance, will be evident in the light of the fundamentals as outlined. In view of the general scope of the discussion, no attempt has been made to outline techniques for determining factors other than in those instances when proper emphasis has required it.

Acknowledgment

The author wishes to express his appreciation to Dr. P. D. Foote, of the Gulf Research & Development Co. for permission to publish this paper; and also to emphasize that the material presented here represents his opinions, and is not intended to reflect the views of the above organization.

Bibliography

1. T. V. Moore, "A Review of Oil-Reservoir Performance," A.P.I. Tenth Mid-Year Meeting, Fort Worth, Tex., May 29, 1940 (Drilling and Production Practice. 1940).

2. Ben W. Sewell, "The Carter Pressure Core Barrel," Drilling and Production Practice, American Petroleum Institute, New York, 69 (1939).

3. D. B. Taliaferro and R. E. Heithecker, "Bureau of Mines-American Petroleum Institute Pressure Core Barrel," Drilling and Production Practice, 53 (1939).

4. T. V. Moore, "Behavior of Fluids in Oil Reservoirs," Bull. Am. Assoc. Petroleum Geol. 22 (9) 1237 (1938).

5. Wyckoff, Botset, and Muskat, Trans. Am. Inst. Mining Met. Engrs. (Petroleum Development and Technology) 103, 219 (1933).

6. Muskat, "Flow of Homogeneous Fluids," Trans. Am. Inst. Mining Met. Engrs. (Petroleum Development and Technology) 103, 606 (1933).

Protection Against Static Electricity

(Continued from Page 140)

is usually a tank of some description, it is of interest to see what happens to the current delivered with the stream. For example, suppose the inlet is below the liquid level. As the stream enters, its velocity drops sharply and the turbulence is reduced greatly. Due to increased dimensions of the container (compared with the pipe), the leakage resistances are increased. It remains for the reduced turbulence of the liquid and the internal pressure of its volume charge to drive the incoming current to the tank walls, where the opposite charge awaits. Both these factors are random in nature; i.e., the turbulence may carry charges in any direction, and the pressure due to volume-charge effect causes the charges to expand like a gas.

For those charged elements that happen to meet the tank wall, all is well; but for those that happen to meet the free oil surface, there is another problem. Charges reaching the free surface cannot reenter the oil body, because that would require work. They must leak away across the oil surface to the tank wall. When the rate of leakage is slow compared to the rate of delivery of charge to the surface, the voltage of the surface can become so high as to break down the electrical resistance of the vapor space and produce a spark.

We have here a hazard which, when understood, is markedly different in configuration from the case of the tire static. To begin with, the accumulation of charge is on the free oil surface. The opposite charge is on the inside of the tank wall. One common precaution, viz., connecting the tank to a ground rod, has no bearing whatever on the problem. This is because the ground rod in no way can become part of a circuit which peacefully will reunite the separated charges.

The treatment of this problem, therefore, must be based on means to prevent or reduce the arrival of static charges at the free oil surface. The problem should be considered also in the light of other more effective generating mechanisms which we shall take up soon, and which also produce charges on the free oil surface. At the moment let us consider the analysis of some practices already avoided as hazardous.

Filling of Tanks from Overhead Inlets

Consider the filling of a tank truck through an overhead fill pipe whose outlet is insulated or is of insulating material (canvas). Assume the stream falls from just inside the tank to the free oil surface.

The charge carried by the stream is delivered directly to the free oil surface, producing a rapidly rising potential here. Part of the opposite charge is left on the canvas or insulated metal fill pipe, where it increases the voltage in the opposite direction. Several hazards exist, in spite of the possible presence of a drag chain and a bond between the truck and piping. If (particularly in small tanks) the surface charge leaks more quickly to the tank than the nozzle charge leaks to the piping, a spark may occur between the nozzle and the filling hatch. If the leakages are related inversely, a spark inside the tank is possible. If both leakages are slow, there may be a spark from nozzle to liquid when the level rises high enough.

All these possibilities are eliminated by the use of a metal filling nozzle that extends to the tank bottom and is bonded to the tank truck and to the piping. By delivering the charged fluid to the tank bottom, the fraction of the charge that can reach the free oil surface is reduced drastically. The charge is delivered instead to the tank wall where, by virtue of the bonding, the opposite charges are waiting.

Filling of Large Tanks

In order to see the electrical picture inside a large tank, we should consider still another mechanism that generates static charges:

The contents of a large tank frequently rest on a layer of water from a few inches to several feet in depth. If a bubble of air or other gas is introduced under this layer, upon rising it will become charged by friction with the oil. At the surface the sudden bursting of the bubble deposits this charge where it is least wanted. If perchance the gas bubble picks up a skin of water at the start, the amount of charge deposited greatly is increased. This is in a good part due to the sudden shrinkage in the water-oil contact area when the bubble skin contracts into a drop of water.

A similar effect in reverse is had when water sprays or chemicals are dumped in through the free oil surface. Here the separation of charges begins on the surface, and a good part of the charges separated just under the surface diffuses to the surface.

The more finely divided the spray, the more contact surface per pound of material is available to separate charges.

In one case the opposite charge is left on the tank bottom; in the other it is carried to the tank bottom. The voltage of the oil surface relative to the inner tank wall is raised, and the hazard is again out of reach of external "grounds" or other outside precautions.

Surface charges are much more serious in large-diameter tanks than in smaller tanks, because in the larger tanks the leakage path is

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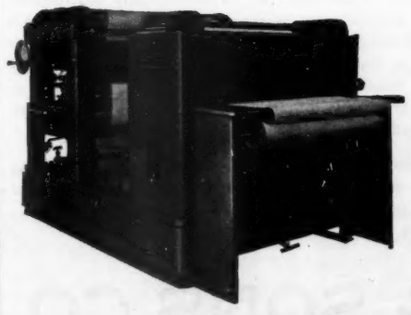

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longer, and the greater electric capacity stores up rather high energies.

The remedies and safeguards against surface charges in large tanks are numerous; and, whereas usual practice does not eliminate the charges, the rate of charging can be kept at a substantially safe low point. To be specific, we can enumerate a few reasonable precautions:

From the nature of the hazard, special care should be used in handling products whose vapor pressures (at tank temperature) are such that combustible mixtures are formed.

The most obvious complete remedy is to have no free oil surface, using floating-roof tanks.

In the majority of tanks in which a free oil surface exists, the principles governing safe practice involve (1) preventing charges already separated from reaching the surface; (2) preventing the generation or deposit of charges on the surface.

To prevent inflowing charges from reaching the surface, inlet lines should be close to the bottom, and the stream should be directed downward. This delivers the stream charge directly to the tank wall and away from the surface. An additional precaution is to pump in at a low rate until 5 or 6 ft. of depth has removed the surface further from the inlet.

To prevent deposit or generation of charges on the oil surface, several precautions are observed:

Air in pipe lines should be bled off outside the tank.

Water in the lines should be displaced with caution. When the inflowing stream is capable of severely agitating the bottom water, low initial flow rates are indicated.

Filling through a raised swing line (over the surface) is a good way to charge the surface, and should be avoided.

Overshot fill pipes that extend to the tank bottom, under some conditions can produce excessive turbulence and even air bubbles, the air being entrained aspirator-fashion from the siphon breaker. When the entrained air represents a hazard, the siphon breaker could be shut off during pumping. Lowered filling rates at the start reduce the rate of charge separation from stirred-up bottom water until surface is raised to a safer distance.

Chemicals to be added to a tank preferably are mixed and fed into the incoming stream, not poured nor sprayed in from above.

Other Static Hazards

The oil industry is confronted with other possibilities of ignition by static charges. Most of these are well controlled already, and are listed here for completeness.

Lightning discharges to tanks are substantially harmless if the tanks are all-steel construction and gas-tight. This is true regardless of the resistance to earth from the tank, as such construction prevents sparks inside the tank. Vapors outside, naturally, are liable to be ignited.

Static charges on men, arising from friction due to motion, are able to produce dangerous sparks. A gager, for instance, can insure discharge of his body by making contact with his bare hand before opening the gage hatch cover. (The use of gaging wells is good insurance against trouble from oil-surface charges in flowing tanks.) . . .

Belt-driven equipment represents a hazard in that one of the charges, riding on the belt, may jump to guards or belt guides. "Static combs" guarantee that a spark will jump. It is possible—for instance, by using high humidity—to keep a belt discharged. However, until belts are made at least semiconducting and are run on metal pulleys, it will be generally safer not to use them in an explosive atmosphere.

In conclusion, let us note that most of the common precautions now used as protection against static electricity are effective. To date, in every case of record in which some safeguard failed to work, either the remedy had been misapplied or there had been more than one mechanism of charge separation and accumulation, one of which had not been accounted for by the steps taken.

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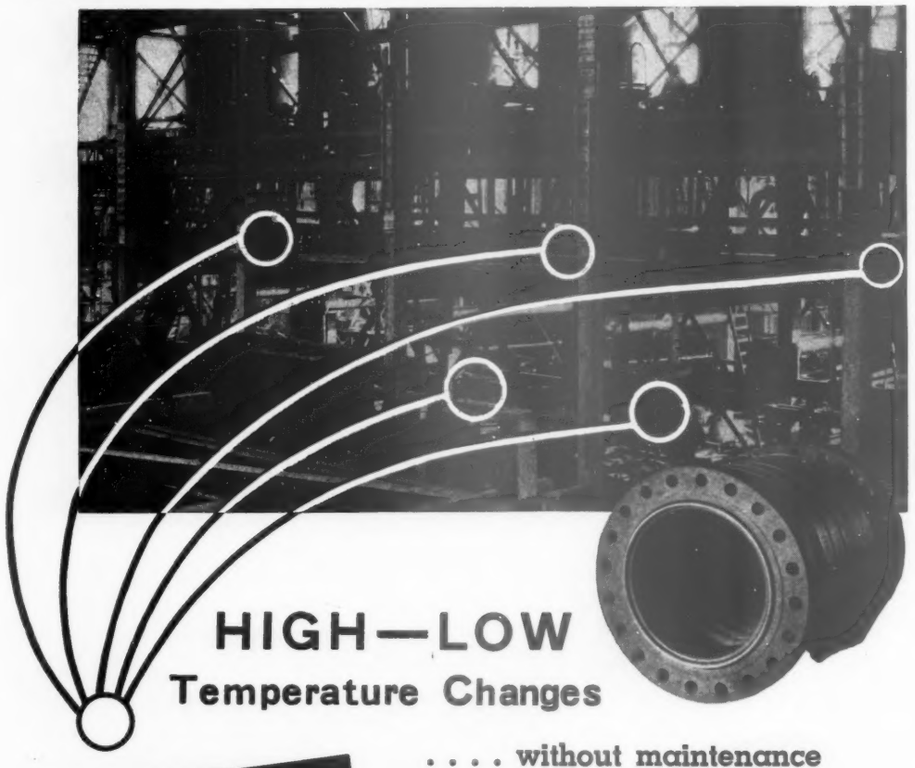

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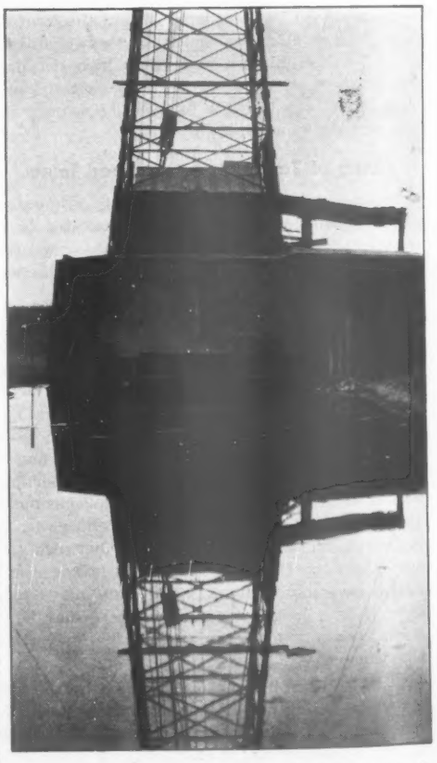

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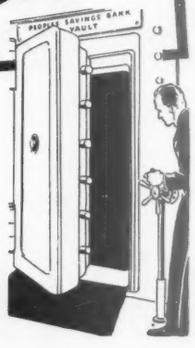

A valve must provide positive closure, even after years of service in the open position. The *best* valve guarantees this effect with wide, *self-releasing* 30° angle wedges, and *flexible-action* gates which automatically adjust themselves to seats. It permits no pressure shock.

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Emulsion Deoiling Process

(Continued from Page 117)

employing a 60-in. centrifugal is given in Table 4. Typical operations are shown for Mid-Continent pressed slack wax and for the rerunning of sweater foots oil to recover the scale wax contained therein. The operation on an 86° F. cold-test sweater foots oil producing an 80° F. cold-test filtrate and a 113° F. melting-point cake is of particular interest, and demonstrates a versatility which should be of value in plant practice.

A distinguishing feature of emulsion deoiling is the compactness of the equipment, as evidenced by the installation of a 400-bbl.per-day unit in a box car. All process heat requirements are met by low-pressure exhaust steam and, therefore, wax-production capacity is obtained without additional boiler load. The equipment may be operated at emulsion temperatures within 4° to 5° F. of the cooling-water temperature. Refrigeration, therefore, is required only when the plant cooling-water temperature is in excess of approximately 80° F. Based on representative refinery utility costs, the total direct operating cost, including labor, is only 4 to 5 cents per barrel of charge for a single-stage operation of the type shown in Table 4. This operating cost is far lower than that usually encountered in conventional sweating. The operating cost of 10.4 cents per barrel for rerunning the foots oil shows a saving over conventional methods of recovering this wax.

Conclusions

This paper presents a new process for deoiling crystalline waxes, and summarizes the pilot-plant and commercial operations. The process utilizes water emulsions to effect continuous wax-oil separations. No expensive solvents nor solvent-recovery equipment is required. The processing time is a matter of minutes, rather than of days; and, therefore, automatic control is immediately effective. The plant cost and operating cost are low, and only exhaust steam is required for heating. The method may be applied to the complete processing of slack wax to semirefined grades, or may be used as an adjunct to existing sweating equipment.

The emulsion wax-separation processes are covered by the following Unied States patents issued to Schutte: Nos. 2168140; 2168141; 2168142; 2168143; and 2168306; and pending applications for patents. The Lummus Co. is the sole licensor.

TABLE 3—PLANT DATA, EMULSION DEOILING OPERATIONS, COMMERCIAL OPERATION, 48-IN. CENTRIFUGAL

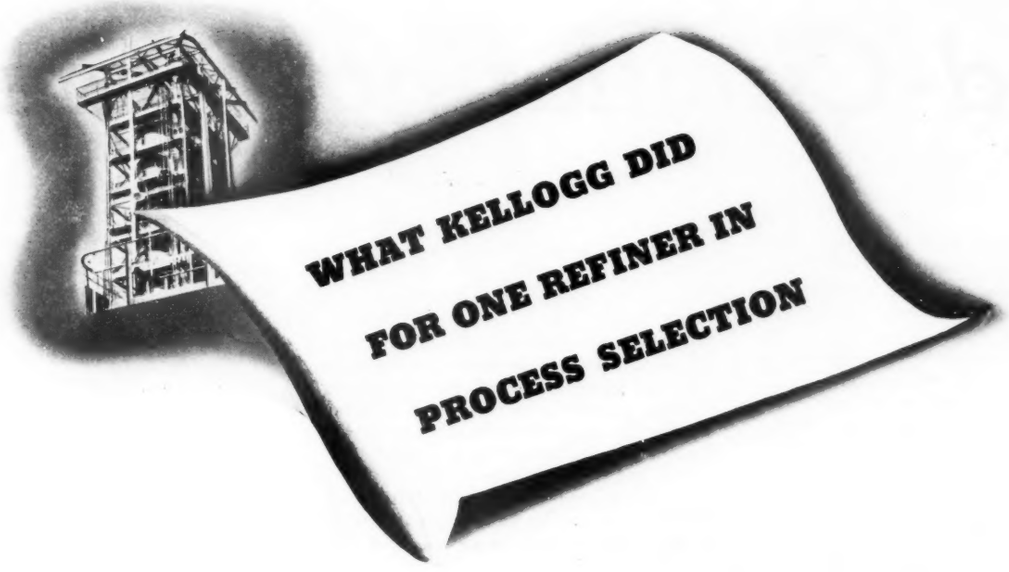
	A B-A slack wax from distillate 125-viscosity	B Cycle from "A"	C B-A slack wax from 50 per cent 80-viscosity and 50 per cent 250-viscosity distillate	D Accumulated filtrate from other operations	E cake from "D"	F B-A slack wax from 155-viscosity distillate
Charge stock:						
Melting point, A.S.T.M., °F.	125-127	124	118.6	114.4	123	120
Oil (press method), per cent	4-11	5	14.3	21	1.3	6
End point at 10 mm., °F.	590-615	...	680 to 700+	....	....	....
Cake:						
Volume per cent on charge	52	45.2	47.3	48	52	43
Volume per cent on slack wax	52	8.6	47.3	....	....	....
Melting point, A.S.T.M., °F.	130-131	129.1	128.6	123	129	130
Oil (press method), per cent	0.4-0.7	0.4	0.4	1.3	0	0
Filtrate:						
Volume per cent on charge	29	54.8	52.7	52	....	....
Volume per cent on slack wax	29	10.4	52.7	....	....	....
Melting point, A.S.T.M., °F.	118	118.8	110	....	....	....
Oil (press method), per cent	.....	13.3	....	106	....	....
Cycle:						
Volume per cent on charge	19	....	....	....	....	....
Volume per cent on slack wax	19	....	....	....	....	....
Melting point, A.S.T.M., °F.	124	....	....	....	....	....
Oil (press method) ("A" and "B"), per cent	5	....	....	....	....	....
Overall scale wax, volume per cent on slack wax	60.6		....	....	....	....
Overall filtrate, volume per cent on slack wax	39.4		....	....	....	....
Charge rate, bbl. per day	396	495	....	430	430	400
Exhaust steam, lb. per hour	660 (40 lb. per bbl.)	....	....	....	....	....
Water, no reuse, gallons per minte	19 (69 gal. per bbl.)	....	....	....	....	....
Power, kilowatt hours	26.5 (1.62 kw.-hr. per b	.... bl.)	....	....	....	....
Utility costs:*						
Steam, cents per barrel of slack wax	1.000	....	....	....	....	....
Water, cents per barrel of slack wax	0.035	....	....	....	....	....
Power, cents per barrel of slack wax	0.81	....	....	....	....	....
	1.845					

*Steam at 25 cents per 1,000 lb.; water at 5 cents per 1,000 gal.; power at 5 cents per kilowatt hour.

TABLE 4—PLANT DATA, EMULSION DEOILING OPERATIONS, 60-IN. CENTRIFUGAL

	Slack-wax from Mid-Continent crude		Sweater foots oil
Charge:			
Throughput, bbl. per day	620	(750 gross)	338
Volume per cent of cake on charge	68.0		14
Charge inspections:			
Melting point, A.S.T.M., °F.	106.8		86
Oil (press method), per cent	45+		Cold test
Cake inspections:			
Melting point, A.S.T.M., °F.	116.5		113
Oil (press method), per cent	16		26
Filtrate inspections:			
Melting point, A.S.T.M., °F.	85		81
Cold test, °F.	82		80
Cloud test, °F.	85.8		81.5
122°F.-melting-point wax (solvent method), per cent	14.3		10.5
Direct operating cost, in cents per barrel of charge:			
Power 1.3 kw. per bbl.	1.0	2.5 kw. per bbl.	1.62
Water, at 77° F. 345 gal. per bbl.	0.17		Reused
Refrigeration	....	36.5 tons*	1.69
Labor, one man per shift	3.0		7.16
Total	4.17		10.41

*Based on reuse of water and net cooling by steam-jet refrigeration.
Water at one-half cent per 1,000 gal. at 77° F. Power at one-half cent per kilowatt.



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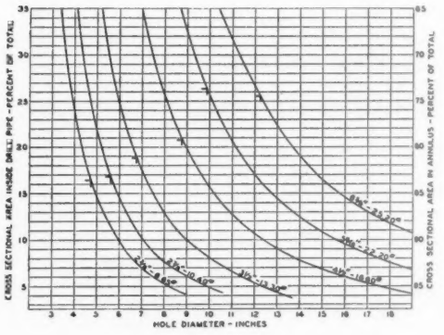
Hydraulics of Mud-Circulating Systems

By WESLEY W. MOORE
Tulsa, Okla.

MUD-LADEN fluid, as used in the drilling of wells by the rotary method, is called on to perform numerous functions. It serves primarily, however, as a vehicle for transporting drill cuttings from the bottom of the hole up to the surface, where they can be deposited. The desired characteristics of the mud, with reference to its physical and chemical properties, will be governed largely by the relative importance of the various purposes to be served at any one particular moment during a drilling operation.

Although there may be what is considered an "average" mud, it cannot be stated accurately that there is a "general-purpose" mud, for the reason that characteristics most favorable for one condition may be least favorable for some other condition in the hole which occurs simultaneously. Mud control, therefore, which represents in its broader aspect a logical compromise under such varying conditions, is entirely beyond the scope of this paper. This discussion relates rather to the means of efficiently circulating an average mud down to, and back up from, the bottom of the hole in volume adequate for effectively removing cuttings from the hole. Special reference is made to some of the factors to be considered in choosing the more favorable combinations of hole diameter, drill-pipe size, pump capacity, and prime-mover rating to be used in drilling a hole into which a given size and length of casing is to be set.


CROSS SECTIONAL AREA INSIDE DRILL PIPE - PERCENT OF TOTAL
CROSS SECTIONAL AREA IN ANNULUS - PERCENT OF TOTAL
HOLE DIAMETER - INCHES

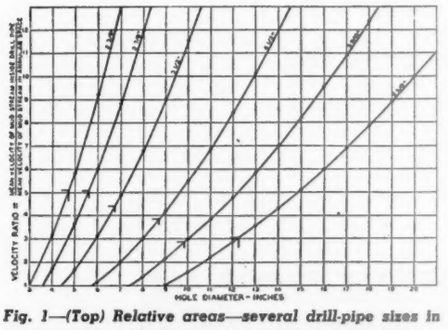


Fig. 1—(Top) Relative areas—several drill-pipe sizes in holes of various diameters. Fig. 2—(Bottom) Mud-stream velocity ratios for several drill-pipe sizes in holes of various diameters

A. P. I.

This discussion does not relate to mud control nor mud conditioning, about which much already has been published. It deals rather with a preliminary analysis of the problem of circulating an average rotary-drilling mud down to and back up from the bottom of the well bore in such volume and at such velocity as effectively to remove drill cuttings from the face of the formation being contacted by the drill bit and to transport such cuttings up to the surface, where they can be deposited.

The useful work accomplished by the circulating mud stream is normally very small in relation to the energy expended. Much of the hydraulic energy, furnished by the slush pump, is consumed by friction head within the drill pipe; whereas no useful work is accomplished by the mud stream until after it has left the drill bit. In most instances the overall mechanical efficiency of the mud-circulating system can be improved by closer attention to the relationship of hole diameter, drill-pipe size, and slush-pump capacity. Included with this paper are charts and tables which it is believed may assist in analyzing the problem which here is introduced.

Paper was presented before Division of Production, at annual meeting of the American Petroleum Institute, Chicago, November 11-15, 1940.

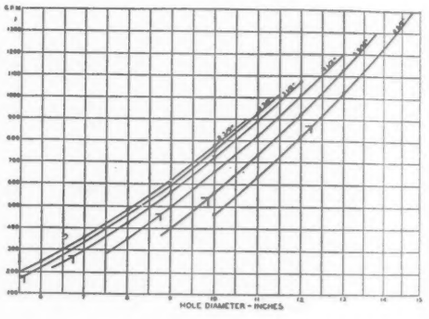
Whereas some of the principles involved in this discussion may apply generally, these analyses refer more particularly to conditions such as are found in the greater Mid-Continent area, where formations penetrated by the drill bit are generally firm and require the more or less continuous use of so-called "rock bits." In the Mid-Continent area little or no importance can be attached to the jetting action of the high-velocity mud stream as an actual hole-making agent. Here also it is presumed generally that a rate of circulation which effectively elevates the drill cuttings will be adequate also for keeping both the bit and the bottom of the hole clean and free of debris.

Experience has taught that certain combinations of drill-pipe size, hole diameter, and rate of circulation are conducive to successful and economical drilling operations. Relatively high mean velocities in the returning mud stream appear to be an important factor in this connection and, although desirable, often are limited in application by friction head developed within the mud-circulating system—particularly within the drill pipe itself.

Within practical limits the friction head (or pressure drop) developed in any given mud-circulating system varies as the 1.85 power of the mean velocity of flow within the system, whereas the hydraulic-horsepower output of the slush pump, which maintains this circulation, varies as the 2.85 power of such velocity. In view of these relationships it is apparent that if the power requirements of the slush pump are to be kept within reason, and if the mean velocity of the returning mud stream also is to be kept at the desired higher rate, careful attention must be given to one important factor in the mud-circulating system, viz., the relation of the hole diameter to drill-pipe size.

Trend in Casing Size

The rotary method of drilling first was introduced successfully into the Mid-Continent area during the development of the Seminole field, about 15 years ago. It was the practice at that time to drill to a depth of 4,200 ft., using a 6⅝-in. o.d. drill pipe with an 11-in. bit, and then to set 8⅝-in. o.d. casing. Slush pumps capable of delivering approximately 600 g.p.m. soon came into general use. The inherent advantages of this program were such that mean velocities of returns could be maintained at about 200 ft. per minute with only moderate pump pressure.



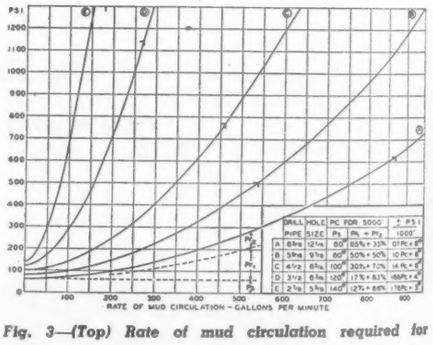


Fig. 3—(Top) Rate of mud circulation required for velocity of 200 ft. per minute in annulus. Fig. 4—(Bottom) Approximate circulating pressure (PC) for 5,000-ft. depth

In more recent years, due to economic conditions generally and due to continued search for new oil reserves at greater depths, the trend has been toward smaller sizes of casing for the production string. During the past 2 years preference for 5½-in. o.d. casing has made rapid gains over the still-popular 7-in. o.d. size. Some operators prefer 6-in. o.d. over 5½-in. o.d. casing, whereas

(Continued on Page 212)

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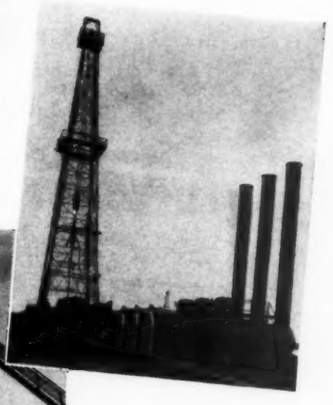

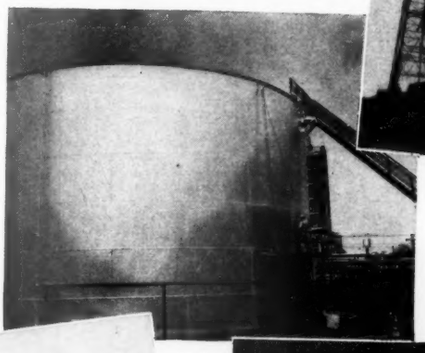

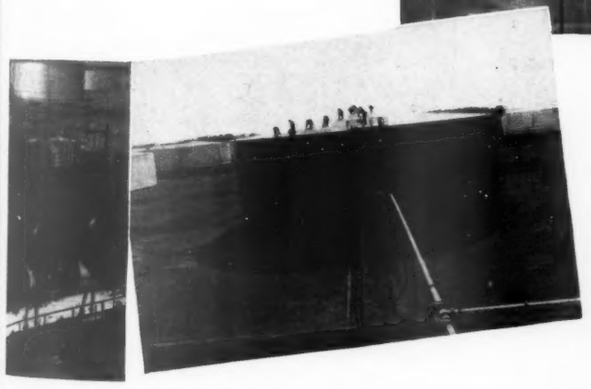

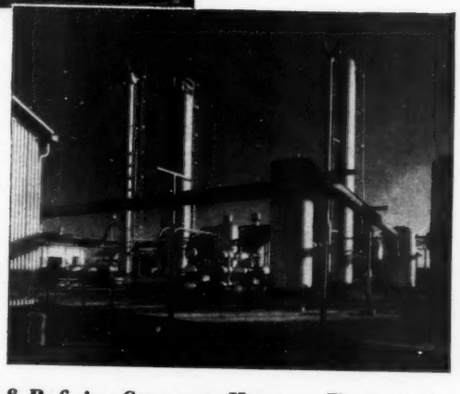

of Louisiana, New Orleans, La. • In Texas by *Humble Oil & Refining Company*, Houston, Texas • In Oklahoma and Kansas and parts of Missouri by *The Carter Oil Company*, Tulsa, Oklahoma • In Kentucky, Georgia, Florida, Alabama and Mississippi by *Standard Oil Company (Ky.)*, Louisville, Kentucky • In other states by *Penola Inc.*, Pittsburgh, Pa. • In Canada by *Imperial Oil Ltd.*, Toronto, Canada.

some others use as small as 4½in. o.d. casing in certain areas. As yet we have not had sufficient experience drilling holes into which to set these smaller sizes of casing to show conclusively the most economical drilling program.

Obviously the minimum size of hole for consideration is one that provides adequate clearance for running, circulating, and cementing the casing. The exact amount of clearance considered safe will vary with local conditions, and to some extent with the depth of hole to be cased. However, it does not follow necessarily that such minimum hole size, thus determined, is likewise the most economical size to drill, unless by chance it affords also the possibility of using safely, and with sufficient clearance for fishing, some standard size of drill pipe large enough to permit circulation of sufficient mud at moderate pressures to produce the desired mean velocity of returns in the annulus.

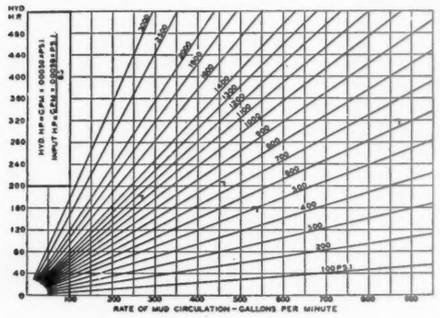

Fig. 5—Hydraulic horsepower required of slush pump

Factors Involved

The useful work accomplished by the circulating mud stream is normally very small in relation to the energy expended. Much of the hydraulic energy supplied by the slush pump is consumed by friction head in the flow of mud down through the drill pipe, whereas no useful work is accomplished by the mud stream until after it first has left the bit. The mechanical efficiency of the system is accordingly very low and, therefore, presents an interesting field for study. The charts herein may assist in an analysis of the various factors involved, but no final and complete answer to the problem is attempted here.

The several charts designated Fig. 1, Fig. 2, Fig. 3, and Fig. 5 result from simple mathematical deductions, whereas the chart designated Fig. 4 is empirical in form and only tentative as to values shown therein.

Fig. 1 illustrates graphically some basic comparisons between cross-sectional areas inside standard sizes of drill pipe, and the annular area outside the pipe when employed in drilling holes of various diameters. For the sake of convenience each such area is expressed in per cent of total cross-sectional area of the entire hole, less that occupied by the material in the pipe. It is rather obvious that the higher the percentage of area inside the drill pipe, the more favorable such combination.

Fig. 2 shows essentially the same fundamental relationships as are shown in Fig. 1, except that in Fig. 2 the resulting mud-stream velocity inside the drill pipe is compared directly with that in the annulus. Inasmuch as the primary function of the circulating mud stream—viz., removal of cuttings from the well—is performed in the annulus, and as relatively high velocities are desirable in attaining this result, the velocity ratio as shown must be kept low in order to prevent limitation of circulation through excessive pressure drop in pumping down through the drill pipe.

Fig. 3 shows, for a large number of possible combinations of drill-pipe size and hole diameter, the rate of mud circulation, in gallons per minute, required to produce in the annulus an arbitrarily chosen mean velocity of 200 ft. per minute.

Fig. 4 illustrates graphically the slush-pump pressures resulting from various rates of mud circulation at an assumed well depth of 5,000 ft. for the five most commonly used sizes of drill pipe, in combination with hole diameters in which perhaps they most commonly are employed. As stated hereinbefore, these curves are empirical in form and are subject to revision as to values, inasmuch as they represent conclusions of the author based only on observations and other such data as were available to him. It is believed, however, that for any given mud-circulating system used in a well-drilling operation, the resulting mud-circulating pressure may be broken down into three principal components: P_s, P_{f_1}, and P_{f_2}.

P_s, herein used to designate shearing pressure, is the pressure required to start the flow of drilling mud, which is not regarded as a perfect liquid, because a large proportion of solids is present. The shearing pressure varies directly as the well depth, but is apparently uninfluenced by variation in rates of circulation. The values, expressed in pounds per square inch per unit of well depth, are dependent on the physical properties of the mud and the nature of the combined flow channels. The values used in plotting curves shown in Fig. 4 are those given by Herrick[1] for 70-lb. mud.

P_{f_1}—herein used to designate pressure drop resulting from fluid friction in fixed accessories

TABLE 1

Displacement in Gallons per Minute, Duplex Slush Pumps

8-in. stroke. (1¾-in. piston rod deducted)

Liner size (inches)	Revolutions per minute					
	1	50	55	60	65	70
4	1.5742	79	87	94	102	110
4¼	1.7989	90	99	108	117	126
4½	2.0334	102	112	122	132	142
4¾	2.2882	114	126	137	148	160
5	2.5534	128	140	153	166	179
5¼	2.8322	142	156	170	184	198
5½	3.1246	156	172	188	204	219
5¾	3.4306	172	189	206	223	240
6	3.7502	187	206	225	244	262
6¼	4.0834	204	224	245	266	286
6½	4.4302	222	244	266	288	310
6¾	4.7906	240	263	289	312	335
7	5.1646	258	284	310	336	362
7¼	5.5522	278	305	333	361	389

TABLE 2

Displacement in Gallons per Minute, Duplex Slush Pumps

10-in. stroke. (1¾-in. piston rod deducted)

Liner size (inches)	Revolutions per minute					
	1	50	55	60	65	70
4	1.9677	98	108	118	128	138
4¼	2.2482	112	124	135	146	157
4½	2.5418	127	140	152	165	178
4¾	2.8602	143	157	172	186	200
5	3.1917	159	175	191	207	223
5¼	3.5402	177	195	212	230	248
5½	3.9058	195	215	234	254	274
5¾	4.2882	214	236	257	278	300
6	4.6877	234	258	281	304	328
6¼	5.1042	255	281	306	332	358
6½	5.5378	277	304	332	360	388
6¾	5.9882	300	330	360	390	420
7	6.4557	323	355	387	420	453
7¼	6.9402	347	382	416	451	485

TABLE 3

Displacement in Gallons per Minute, Duplex Slush Pumps

12-in. stroke. (2-in. piston rod deducted)

Liner size (inches)	Revolutions per minute					
	1	45	50	55	60	65
4	2.3088	104	115	127	138	150
4¼	2.6214	118	131	144	157	170
4½	2.9737	134	149	163	178	193
4¾	3.3558	151	168	185	202	218
5	3.7536	169	188	207	226	244
5¼	4.1718	188	209	230	250	271
5½	4.6104	208	230	253	276	299
5¾	5.0694	228	253	279	304	329
6	5.5488	250	278	305	333	361
6¼	6.0486	272	302	332	363	393
6½	6.5688	296	328	361	394	427
6¾	7.1094	316	351	386	421	455
7	7.6704	345	383	422	460	498
7¼	8.2518	372	413	454	495	536

TABLE 4

Displacement in Gallons per Minute, Duplex Slush Pumps

14-in. stroke. (2-in. piston rod deducted)

Liner size (inches)	Revolutions per minute					
	1	40	45	50	55	60
4	2.6936	108	121	135	148	162
4¼	3.0583	122	138	153	168	183
4½	3.4693	139	156	173	191	208
4¾	3.9151	157	176	196	215	235
5	4.3792	175	197	219	241	263
5¼	4.8671	195	219	243	268	292
5½	5.3788	215	242	269	296	322
5¾	5.9143	236	266	296	325	355
6	6.4736	258	291	324	356	388
6¼	7.0567	282	318	353	388	424
6½	7.6636	306	345	383	421	460
6¾	8.2943	332	373	415	456	498
7	8.9488	362	407	452	497	543
7¼	9.6271	386	434	481	529	577

TABLE 5

Displacement in Gallons per Minute, Duplex Slush Pumps

15-in. stroke. (2¼-in. piston rod deducted)

Liner size (inches)	Revolutions per minute					
	1	40	45	50	55	60
4½	3.6087	144	162	180	198	216
4¾	4.0864	163	184	204	225	245
5	4.5836	183	206	229	252	275
5¼	5.1064	204	230	255	280	306
5½	5.6546	226	254	283	311	339
5¾	6.2284	249	280	311	342	374
6	6.8276	273	307	341	375	409
6¼	7.4524	298	336	373	410	447
6½	8.1026	324	365	405	445	486
6¾	8.7784	351	395	439	483	526
7	9.4796	379	426	473	520	568
7¼	10.2064	409	460	510	561	613
7½	10.9586	438	493	548	603	658
7¾	11.7364	470	528	587	645	704

TABLE 6

Displacement in Gallons per Minute, Duplex Slush Pumps

16-in. stroke. (2¼-in. piston rod deducted)

Liner size (inches)	Revolutions per minute					
	1	40	45	50	55	60
4½	3.8493	154	173	193	212	231
4¾	4.3588	174	196	218	240	262
5	4.8892	195	220	244	268	293
5¼	5.4468	218	245	272	299	326
5½	6.0316	241	271	301	332	362
5¾	6.6436	265	298	332	365	398
6	7.2828	291	328	364	400	436
6¼	7.9492	318	358	398	437	476
6½	8.6428	346	389	432	475	518
6¾	9.3636	374	421	468	515	562
7	10.1116	404	455	505	555	606
7¼	10.8868	435	489	544	598	652
7½	11.6892	467	525	584	642	700
7¾	12.5188	500	563	626	688	751

TABLE 7

Displacement in Gallons per Minute, Duplex Slush Pumps

18-in. stroke. (2½-in. piston rod deducted)

Liner size (inches)	Revolutions per minute					
	1	40	45	50	55	60
4½	4.1851	167	188	209	230	251
4¾	4.7583	190	214	238	262	286
5	5.3550	214	241	268	294	321
5¼	5.9823	239	269	299	329	359
5½	6.6402	266	299	332	365	398
5¾	7.3287	294	330	367	404	440
6	8.0478	322	362	402	442	482
6¼	8.7975	352	396	440	484	528
6½	9.5778	382	430	478	526	575
6¾	10.3887	415	467	519	571	623
7	11.2302	449	505	561	618	674
7¼	12.1023	485	545	605	666	727
7½	13.0050	520	585	650	715	780
7¾	13.9383	558	627	697	766	836

TABLE 8

Displacement in Gallons per Minute, Duplex Slush Pumps

20-in. stroke. (2½-in. piston rod deducted)

Liner size (inches)	Revolutions per minute					
	1	40	45	50	55	60
4½	4.6501	186	209	233	256	279
4¾	5.2870	211	238	264	291	317
5	5.9500	238	268	297	327	357
5¼	6.6470	266	299	332	365	399
5½	7.3780	295	332	369	406	443
5¾	8.1430	325	366	407	448	488
6	8.9420	357	402	447	492	537
6¼	9.7750	390	440	489	537	586
6½	10.6420	425	479	532	585	638
6¾	11.5430	462	520	577	635	692
7	12.4780	499	561	624	686	749
7¼	13.4470	538	605	672	739	806
7½	14.4500	577	650	722	795	867
7¾	15.4870	619	696	774	851	929

Note: For actual deliveries deduct 5 to 10 per cent (depending on conditions) from figures shown in Tables 1 to 8.

such as mud lines, hose, swivels, kelly, drill collar, and bit—is assumed to vary as the 1.85 power of velocity (or for any given circulating system, as the 1.85 power of the rate of circulation), but is otherwise constant, as these accessories do not change with well depth.

P_{t_2}—herein used to designate pressure drop resulting from fluid friction within the drill pipe, through the tool-joint restrictions, and in the annulus—is assumed to vary as the 1.85 power of velocity (or rate of circulation as above), and also directly as the depth of the well.

The pounds-per-square-inch values shown for curves *A*, *B*, *C*, *D*, and *E* in Fig. 4, for various rates of circulation in an assumed 5,000-ft. well, are for total circulating pressure "P_c," wherein:

$$P_c = P_s + P_{t_1} + P_{t_2}$$

Except for experiments performed by March and Gilbert,[2] there seems to be little published experimental data on which to base assignment of definite values to P_{t_1} and P_{t_2}. It was necessary, therefore, to consider P_{t_1} and P_{t_2} collectively in plotting curves shown in Fig. 4, with only a suggestive relative value for each, in order to facilitate derivation of a formula for estimating pressures at depths other than 5,000 ft. In general, curves *A*, *B*, *C*, *D*, and *E* have been found to be representative, and reasonably accurate, when checked against a large number of recorded observations made available to the author.

Fig. 5 shows graphically the hydraulic horsepower required of the slush pump to maintain mud circulation at various rates and at various pressure differentials.

Tables 1 to 8, inclusive, show displacement, in gallons per minute, for slush pumps of different sizes operated at various speeds, and are included herewith for the reader's convenient reference.

Conclusions

1. Results in practice, so far as they have been observed, seem to confirm the theoretical advantage of keeping the ratio of drill-pipe size to hole diameter as high as possible, and yet retain adequate clearance for fishing operations.

2. Drilling costs are influenced to some extent by the size, weight, and initial cost of the drilling equipment required for a specific operation. More efficient use of slush-pump capacity, therefore, should result indirectly in lowered drilling costs.

3. The subject, here discussed qualitatively, would seem to be of sufficient importance to warrant further and more scientific study, so that a quantitative analysis of the various factors involved could be made available to the industry.

Bibliography

1. H. N. Herrick, "Flow of Drilling Mud," Trans. Am. Inst. Mining Met. Engrs. (Petroleum Development and Technology) 98, 476 (1932).
2. R. A. March and W. E. Gilbert, "Resistance of Mud Through Regular vs. Full-Hole Tool Joints," Drilling and Production Practice, American Petroleum Institute, New York, 34 (1935).

●

Questions and Answers

Washing Face of Sand Without Use of Pump

We would like to wash the face of the sand in a 4,000-ft. well. Is there any way you can suggest doing this without using a pump?—W. E.

The best way of washing a sand is by rigging up a pump and running the tubing with a perforated joint on bottom. Sufficient pressure can then be applied to force the wash oil through the perforations against the walls of the hole. It is assumed that the washing is to clean the debris from the walls of the hole and bring it into position where it can be removed with a bailer or sand pump.

However, some wells do not justify much expense although the cleaning of the sand face will undoubtedly make it easier for the oil to get in the well bore. In such borderline cases it is necessary to keep expenses at a minimum and the sand is washed without using a pump.

This is done by running tubing to the bottom of the well or opposite the sand face. If the washing is to be done off bottom the first joint of tubing run is bull-plugged on bottom and perforated; perforations can be made with a welding torch and the holes made about ¼-in. in diameter. If the washing is to be done on bottom, the bull-plugged and perforated joint are not necessary.

On top of the first joint, a thin cast-iron plug is inserted in the collar, thus sealing off the upper part of the tubing from the bottom joint. After the tubing is run in the hole it is filled with oil to the top; it is the pressure of the fluid column which is used to wash the hole and this method is particularly effective on deep holes.

The iron plug supporting the fluid column is broken by dropping a weight, generally a cast-iron sash weight, in the tubing. Cast iron is used as it is easy to drill up. Where the bottom of the tubing is closed with a bull plug, any type of weight can be used as it will be recovered when the tubing is pulled from the hole.

As soon as the iron washer is broken, the oil in the tubing rushes out against the wall of the hole. Naturally the pressure of the fluid is reduced as the head in the tubing decreases. Generally, one such treatment is sufficient to clean the sand face but if two treatments are necessary the tubing can be rerun and the operation repeated.

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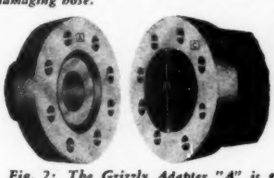

Fig. 2: The Grizzly Adapter "A" is recessed to accommodate the end of the Hose "B" which is built integral with the Coupling "C". Both the Adapter and Coupling Flange are precision machined to perfect fit. The steel-to-steel connection between Adapter and Coupling positively prevents damaging hose in any manner.

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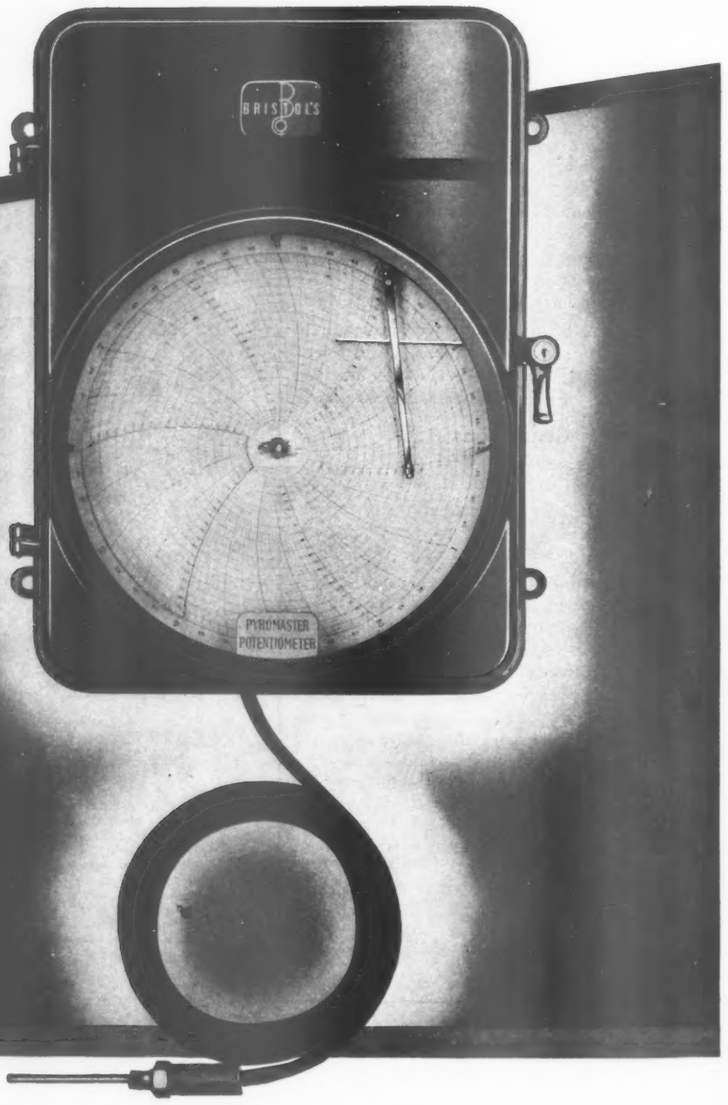

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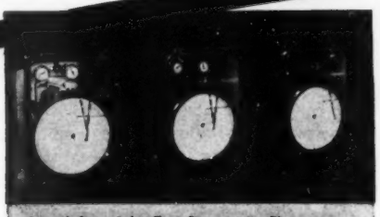

From left to right: Two Pyromaster Thermometer Recorder Controllers, Pyromaster Recording Thermometer.

for watching your temperatures in hazardous atmospheres

Pyromaster Indicating Recorder,—for charting top temperature of stabilizer.

A new potentiometer electric thermometer to meet today's needs! That, briefly, is how one refinery engineer after another has described this modern Bristol's "Explosion-Resistant" Electric Thermometer.

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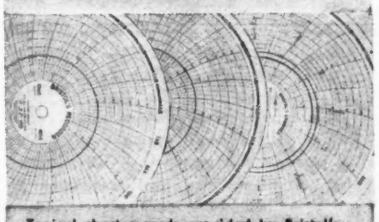
We shall welcome the opportunity to give you the further information on the "Explosion-Resistant" Electric Thermometer you may desire.



Typical chart-records provided by Bristol's Control on important petroleum processing.

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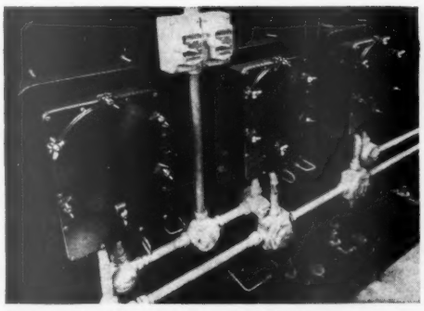
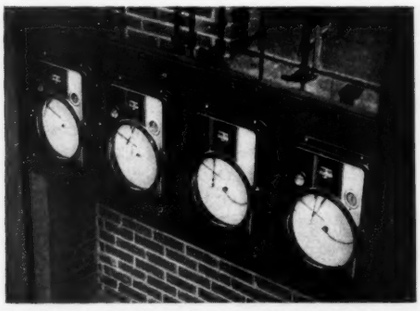
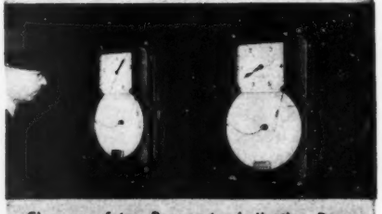


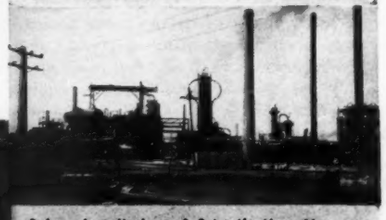
Rear view of three "Explosion-Resistant" Pyromasters, installed in the gas plant of a major refiner.



Two Bristol's Free-Vane Reset Flow Controllers, Flow and Temperature Recorder, and Ampliset Pressure Controller.



Close-up of two Pyromaster Indicating Recorders in turbine room of prominent refinery.



Below: Installation of Bristol's Meta-Vane Controllers in prominent mid-west refinery shown above.

BRISTOL'S

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FOR PRECISION IN PETROLEUM MEASUREMENT

A.P.I. Pipe-Coating Tests: Final Report

By KIRK H. LOGAN
National Bureau of Standards, Washington, D. C.*

IN 1930 the American Petroleum Institute, with the cooperation of manufacturers of protective coatings and the National Bureau of Standards, undertook a study of protective coatings for pipe lines for the purpose of establishing the engineering principles involved in the design, selection, and application of such coatings. The procedures for testing the coatings were agreed upon by the cooperating parties, and have been described in detail by Scott, who supervised the application of the coatings and reported[1,2,3,4] the first three inspections.

The coatings originally were exposed at 16 test sites. Denison has attempted to correlate some of the soil properties with the early performance of some of the coatings in the test.[5]

The coatings tested can be divided into two divisions:

1. Types of coatings each representative sample of which was applied in duplicate to approximately 30 ft. of an operating pipe line or its equivalent. Each of 19 coatings was applied in duplicate sections to the pipe line at from 8 to 12 test sites. Between each group of two coatings applied to the pipe line, 20 ft. of the line were left uncoated. In the same trench at the side of each line coating but not touching it, five 2-ft. sections of bare 3-in. pipe were laid at equally spaced intervals to serve as control specimens. Three such control specimens were laid beside each section of bare pipe line.

2. Each coating applied to line pipe was applied also to 2-ft. lengths of 3-in. boiler tube (hereafter referred to as short pipe sections). Three specimens of each of these coatings and an equal number of specimens of each coating which was applied only to the short pipe sections, a total of 46 varieties of coatings, were buried at each of the 16 test sites as described in Progress Report No. 1.[1] This permits a comparison of all coatings tested on the 2-ft. lengths. . . .

Inasmuch as the original agreement regarding the manner in which the test was to be conducted specified that the names of the makers of the coatings applied to the lines should not be revealed, a comparison of the performances of coatings on the pipe lines and on the short pipe sections will not be made. Ewing[6] has shown that the chief differences between the results of the two tests are caused by: (1) Differences in the exposed areas of the specimens; and (2) more favorable conditions for the application of the hand-applied coatings on the short pipe sections. It is possible that important differences in the behavior of the coatings on the short pipe sections and on the pipe line are caused by the greater weight and the movement of the latter. Line temperature may have had some effect.

(Locations of the test sites and identifying numerals were as follow: (1) Temple, Tex.; (2) Arkansas City, Kans.; (3) Beaumont, Tex.; (4) League City, Tex.; (5) Preble, Ind.; (6) Council Hill, Okla.; (7) Caney, Kans.; (8) Spindletop Gulley, Tex.; (9) Long Beach, Calif.; (10) Mount Auburn, Ill.; (11) Skiatook, Okla.; (13) Bunkie, La.; (14) Chambersburg, Pa.; (16) Cholame, Calif.)

At three of the sites, Nos. 12, 15 and 16, all or part of the specimens were lost because of changes in the plans of the cooperating pipe-line operators. The original plans for the tests called for five inspections of 6-ft. sections of coated pipe line and three inspections of 6-ft. sections of unprotected pipe. These plans will not be carried out, because the condition of some of the coatings at some sites made it desirable to terminate the test with this fourth inspection. The 1940 inspections, therefore, covered all remaining coatings and pipe, i.e., approximately 24 ft. of each line coating, thirteen 8-ft. sections of uncoated line pipe, and 46 coatings applied to short pipe sections at each test site. However, in order that the data to be presented should be comparable with those reported earlier, the first part of this report is based on the examination of 5-ft. lengths of coated pipe line and 4-ft. lengths of uncoated pipe. . . .

Methods of Test

Conductance test.

The method of making conductance tests was described in the second progress report.[3] Ewing[6] and Larson[7] also have described and discussed this test. The conductance of a coating depends, in part at least, on the amount of moisture in the coating, on the amount and character of the salts in solution in the moisture, and upon the character of the clay and pad used in the test. The results of the conductance test may be affected by the moisture content of the soil at the time the test is made and on the amount of time between the removal of the soil from the coating and the start of the test. The results depend also on the number and size of the pinholes and other openings in the coating, and on the extent to which moisture from the clay used in the test has penetrated these openings. The results depend also on whether there is contact between all parts of the coating and the test pad. A low conductance is desirable, as this tends to reduce the currents which inevitably are associated with corrosion. If cathodic protection is to be used, less current will be required if the pipe line is protected by a coating having a low conductance. The fact that for the most part the conductances of the coatings as reported in the several progress reports are consistent is evidence that the test is reasonably reliable. The discrepancies between the results of tests of the two sections of the same coating may be the result of real differences in the two specimens. In many instances there is an obvious difference between them, and sometimes the cause of the difference can be seen. As in the corresponding tables of earlier reports on the coatings applied to the pipe line, the recorded conductance is the higher of the results of two tests.

Pattern test.

The pattern test was designed to locate discontinuities in the coatings. Wet absorbent paper is wrapped around the coated pipe, and a voltage is applied between the pipe and an electrode in contact with the paper. The pipe is made the anode. Current flowing through holes in the coating, which is an insulator or dielectric, carries ferrous ions into the paper. When the paper is dipped into a solution of potassium ferricyanide, blue spots are developed by the reaction of the ferrous ions and potassium ferricyanide at the points corresponding to the points at which current passed through the coating. The test was developed by Scott[2] and Ewing.[6]

The results of the pattern tests as presented by Scott, and in the tables to be presented, should be used with caution for comparing coatings, because they do not show the extent of the blue areas resulting from the test. A pattern record showing a single blue spot less than the size of a pinhead and another record showing spots covering 10 per cent of the area of the pattern paper are both reported as positive patterns. On this account the condition of one coating showing a positive pattern may have been much worse than another. Although the coating showing the larger blue area may be in the worse condition, any pattern caused by the passage of current, regardless of area, indicates an imperfection in the coating. The conductance of the coating is a somewhat better measure of the condition of the coat-

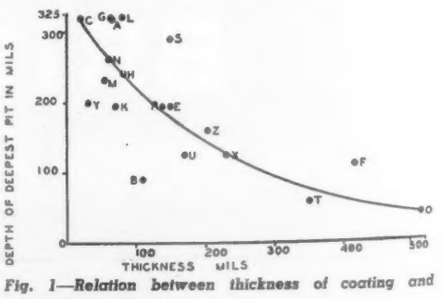

Fig. 1—Relation between thickness of coating and depth of deepest pit

*Publication approved by the director of the National Bureau of Standards, U. S. Department of Commerce, Washington, D. C.

A. P. I.

The accompanying article is an abstract of the fifth and final report of the central committee on pipe-line transportation on the results of a study on pipe-coating tests undertaken by the group in 1930. The coatings originally were exposed at 16 test sites.

The paper was presented before the Division of Production at the annual meeting of the American Petroleum Institute at its annual meeting in Chicago, November 11-15, 1940.

ing, as the conductance depends in part on the areas of the opening so long as they are very small. The conductance of the coating should be proportional to the density of the pattern unless an appreciable area of the pipe is exposed, in which case the conductance is not measurable by the apparatus used in the test.

As on former occasions, two pattern tests were made on each section of the coating applied to the line pipe. The earlier reports on the pattern test indicate only whether at least one positive pattern was obtained.

Depths of the deepest pits.

The use of pit depths as a measure of the effectiveness of coatings is open to question, as the depth of the pit is a function of the corrosivity of the soil as well as the protective value of the coating. Nevertheless, the condition of the pipe must be given due consideration in evaluating the effectiveness of a coating; and it has been shown[8] that pit depths are a reasonably good, though not an accurate, measure of the condition of the pipe.

TABLE 1—DEPTH IN MILS OF THE DEEPEST PIT ON SPECIMENS BURIED WITH COATED SHORT SECTIONS

Site	Age (years)	Specimen 1	2	3	4
1	9.63	47	42	26	29
2	9.83	39	36	54	50
3	9.82	(*)	(*)	(*)	(*)
4	9.68	49	53	49	55
5	9.84	41	43	36	45
6	9.87	46	51	35	47
7	9.89	35	40	38	33
8	9.73	†94	†94	(*)	83
9	9.45	(*)	95	95	
10	10.03	37	47	52	37
11	9.76	63	60	65	62
12	9.46	108	103	87	100
13	9.71	(*)	(*)	113	(*)
14	9.86	61	43	46	47
15	9.66	(*)	(*)	(*)	(*)

*Hole in pipe; wall thickness 148 mils. †Indicates that the original surface of the pipe had corroded away, making it impossible to determine the true depth of the corrosion.

In earlier reports the deepest pit on each section of pipe inspected was reported, although the areas of the sections examined differed greatly. . . . It has been shown, however, by Scott[9] and others[10] that, as a rule, the depth of the deepest pit on any area increases with increased exposed area, i.e., the average of the depths of the deepest pit on a number of large areas will be greater than the average of the depths of the deepest pit on smaller areas. Because of this fact, if pit depths are to be compared, they should be chosen from equal areas or adjusted to take account of the difference in the areas. . . .

It should be remembered too that the depth of the deepest pit is, to some extent, a matter of chance, i.e., two sections of pipe exposed to nominally the same soil conditions may differ greatly with respect to the depths of their deepest pits. . . .

Inspection of the coatings.

Each coating was examined also according to a code agreed upon by an association of manufacturers of coatings. These observations cannot be tabulated, and are far too bulky to be presented in detail in a paper. Moreover, the appearance of the coating is of minor importance. A brief description of the appearance of each coating was written. A photograph of each section of coating was taken. . . .

The pit depths on the line pipe and control pipe given for Spindletop Gully, Site 8, were measured on corroded surfaces in many instances and are, therefore, less than the total penetration of the pipes by corrosion. Few control specimens were found opposite the uncoated line at this site. The pit depths at Sites 6 and 10 are not much greater than some recorded at the time the coatings were applied, at which time the line was about 3 years old. It is possible, though not probable, that some of the pits measured at this site were old ones. An effort was made to locate and avoid the old pits.

At some of the sites the maximum pit depths on different sections of the line differed considerably. Whether such differences were accidental or indicated differences in soil corrosivity cannot be determined easily. Certainly, the differences were not greater than frequently are encountered on similar lengths of other pipe lines. . . .

Table 1 (author's Table 7), in addition to showing the duration of the tests at each site, shows the pit depths on the bare pipe, buried with the short sections of coated pipe. These bare sections were intended to form a basis for estimating the effectiveness of the coatings buried with them. . . .

At Sites 6 and 10 the coatings were applied to pipe which had been in service for several years. When the coatings were applied at Site 6, the location and depth of the maximum pit on each foot of pipe was recorded. Because of the numerous pits at Site 10 the recording finally was reduced to the tabulation of the deepest pit on each foot. An attempt was made to locate and avoid measuring these pits when the 1940 inspections were made, but it is possible that the old pits were not recognized in every case. The data indicate that, in general, there are deeper pits on the coated sections in 1940 than were observed on similarly coated sections in 1934, although there are some exceptions to this observation. . . .

Although there seems to be a trend toward shallower maximum pit depths as the thickness of the coating increases, as shown in Fig. 1 (author's Fig. 2), there are several exception to this rule. For example, at most sites the pitting under coating *G* was less severe than is indicated by the curve in Fig. 1. Under the grease coating *B* the maximum pit depth was less than that under some of the thicker coatings. The pitting beneath coating *B* frequently took the form of pinholes, i.e., pits of very small diameter.

The addition of a heavy layer of cement-sand mortar to coating *A* to form coating *F* reduced the pit depths at all test sites where those coatings can be compared. The addition of an impregnated asbestos-felt shield to coating *N* to form coating *G* resulted in reduced pit depths, but did not eliminate relatively deep pits. The application of wood veneer applied over coating *L* to form coating *H* did not prevent the formation of deep pits. At most sites very little of the veneer remained. The shielding of coating *Z* with a sheet of thin steel to form coating *X* resulted in shallower pit depths beneath the latter coating at all but one site. The steel shield rusted badly, but much of it remained at many of the sites at the close of the 10-year

TABLE 2—SUMMARY OF CONDITIONS OF LINE PIPE UNDER COATINGS

Symbol	Coating: Thickness (Mils)	Coating: Associated Coating	Coating: Character	Coating: Structure	Total Feet Inspected	Unaffected: Total Feet	Unaffected: Per Cent	Rusted: Total Feet	Rusted: Per Cent	Metal Attack: Total Feet	Metal Attack: Per Cent	Pitted: Total Feet	Pitted: Per Cent	Depth Deepest Pit (Mils)
1. COLD APPLICATIONS														
C	21	Y	Cutback coal tar	$2C_1^c$	166	2	1.2	9	5.4	16	9.6	139	84.5	322+ *
A	65	F	Asphalt emulsion	$2L_3$	178	0	0	0	0	3	1.7	175	98.3	322+ *
2. ENAMELS														
N	60	G	Coal-tar–asphalt enamel	p_1^c; E_1^{ac}	152	21	13.8	21	13.8	16	10.7	94	62.0	264
K	69	U	Coal-tar–asphalt enamel	p_2^c; E_2^{ac}	183	13	7.2	15	8.2	54	29.6	101	55.0	195
M	58		Coal-tar enamel	p_4^c; E_4^c	151	0	0	0	0	3	2.0	148	98.0	231
L	80	H	Coal-tar enamel	p_5^c; E_3	157	31	19.8	6	3.8	10	6.4	110	70.1	322+ *
3. MASTIC														
O	519		Asphalt mastic	p_{10}^a; $\overline{B_3; M; e:s}$	213	154	72.5	39	18.4	14	6.6	6	2.8	38
4. SHIELDED COATINGS														
Y	29	C	Cutback asphalt	p_9^a; C_2; C_3; $\bar{n}$	164	2	1.2	17	10.4	30	18.3	115	70.0	200
F	419	A	Asphalt emulsion	$2L$; d	170	6	3.5	66	39.0	37	21.8	61	35.9	107
G	63	N	Coal-tar–asphalt enamel	p_1^c; E_1^{ac}; f_2^a	202	59	29.3	36	17.9	51	25.3	56	27.8	322+ *
H	81	L	Coal-tar enamel	p_6^c; E_3:v	177	76	43.0	7	4.0	9	5.1	85	48.0	240
5. REINFORCED COATINGS														
B	107		Grease	G_1; f_1^o; G_2	208	0	0	9	4.3	61	29.4	138	66.3 *	89
S	150		Asphalt	p_{13}^a; $\overline{2B_3; f_{10}^c; B:k}$	166	0	0	2	1.7	39	23.5	125	75.3	290
E	151		Asphalt	p_8^a; B_1; f_3^c: B:k	192	9	4.7	17	8.9	70	36.5	96	50.0	197
Z	201	X	Asphalt	B_2; $\overline{2(B_2 + f_3^o); k}$	228	1	0.4	22	9.7	105	46.1	100	44.1	160
R	143		Asphalt enamel	p_{12}^a; $\overline{2E_3; f_7^a; E:k}$	208	42	20.2	19	9.2	42	20.2	105	50.5	197
U	171	K	Coal-tar–asphalt enamel	p_2^c; $\overline{2E_2^{ac}; f_3^a; E:k}$	218	67	30.8	13	6.0	51	23.5	87	39.9	126
T	351		Coal-tar enamel	p_7^c; $\overline{2(E_3; f_4^{a-}); E}$; w	175	26	14.9	25	14.3	58	33.1	66	37.7	58
X	230	Z	Asphalt	B_2; $\overline{2(B_2 + f_3^o); m}$	229	12	5.2	31	13.5	140	61.1	46	20.1	124
Total	...	..			3,537	521	14.7	354	10.0	809	22.9	1,853	52.2	..

* Through pipe.

period of exposure. Neither coating *X* nor *Z* entirely prevented corrosion at any test site.

Because of the number of variables involved in the application structure and materials of the coatings, it is impossible to determine positively from the data . . . whether machine application of a coating is superior to hand application. The hand-applied coating *E* appears to be slightly superior to the machine-applied coating *S*, which is of about the same thickness. However, they differ in the softening points of the asphalts and the type of reinforcement. The machine-applied reinforced asphalt coating *Z*, which is 33 per cent thicker than coating *E*, appears to have been somewhat more effective than the latter in the more corrosive soils. Both coatings have cotton-fabric reinforcing materials, but that in coating *E* was saturated with coal tar while in the coating *Z* was saturated with asphalt.

The field-applied reinforced coal-tar enamel coating *T*, which is twice as thick as the somewhat similar machine-applied coating *U*, was superior to the latter at most test sites. These coatings differed in the type of enamel and reinforcement as well as in thickness.

. . . It was noted that the average of the depths of the deepest pits beneath several of the coatings is at one or more test sites greater than that for the adjacent unprotected sections of line pipe. Although it is possible to account for this condition by assuming that the corrosion of the coated pipe was accelerated by long-line currents or by the adjacent bare pipe, it is doubtful whether many will accept such an explanation in the absence of definite evidence to support it. . . .

Table 2 (author's Table 12) is a summary of the conditions of the pipes beneath the coatings at all the test sites. Like most summaries it omits details which under some circumstances may be important, and care should be used in drawing conclusions from it. Not all of the coatings were exposed to the same soil conditions; and, as the sites differed greatly in corrosiveness and the coatings differed greatly in the way the corrosion was distributed beneath their surfaces, it is probable that the table does not show accurately the relative merits of the coatings.

Conclusions as to what the coatings might have done if they had been applied better are left to the reader, as are conclusions as to the extent to which coating materials and methods have been improved since 1930. It would be helpful to the users of pipe coatings if some of the newer types of coating which have been in the ground for a few years could be examined carefully and the condition of the pipe beneath them determined.

Conclusions

Summary of observations.

The data on the conductance of the coatings lack uniformity. Not infrequently one section of a coating showed many times the conductance of another section of the same coating at the same test site. In many cases it is difficult or impossible to determine whether this lack of consistency is the result of lack of uniformity in the thickness or composition of the coating, poor application, or nonuniform soil conditions. The same statements are applicable to maximum pit depths. The important fact is that the amount of protection afforded by many coatings was not uniform even under nominally the same condition. Either the coatings as applied were not uniform or they lacked a sufficient factor of safety to provide against the variations in the exposure to which they were subjected.

There was a general increase in the conductance of the coatings over that observed in 1934. This indicates that the usefulness of the coatings is limited with respect to time. There are individual exceptions to this generalization.

As a class, the coatings which were applied cold and were not reinforced or shielded showed more cases of exposed pipe than did the thicker coatings.

Zinc chromate and baked-on red and blue lead appear to be satisfactory as undercoats under the conditions to which they were subjected. The bond between the undercoats and the pipe was stronger than that between the undercoats and the coatings applied over them. These undercoats seem to have reduced corrosion, but did not afford adequate protection to pipe in corrosive soils.

The number of coated pipe showing patterns was greater in 1940 than in 1934, although some sections which showed a positive pattern in 1934 showed none in 1940. The pattern tests indicate a continued decrease in the effectiveness of most coatings.

Only four test sites were severely corrosive, as indicated by the depths of the pits on unprotected sections of pipe. The majority of the test sites were, therefore, favorable to the coatings if pit depths are used as criteria for the effectiveness of the coatings. There is no consistent difference between the depths of the deepest pits on uncoated sections of line pipe and on the short pipe sections.

On the average the pipe under more of the coatings showed corrosion in 1940 than in 1934, and the maximum pit depths were greater for most coated sections.

In general there were fewer pits under thick coatings than under thin ones, but the depths of the pits under a coating were sometimes greater than under a thinner one.

Because the coatings differ in many ways, it is impossible to determine positively whether the machine-applied coatings were superior to those applied by hand or to determine the relative merits of coal tar and asphalt as protective coatings. Likewise the data do not show clearly whether impregnated asbestos felt was superior to organic materials as a reinforcement. However, as a shield it did

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not deteriorate as did the organic materials. It is evident that the layer of cement-sand mortar over the bituminous coating was insufficient to prevent serious pitting in a corrosive soil.

All of the coatings reduced the number of pits per unit area of surface, and most of the coated sections of pipe showed shallower maximum pit depths than occurred on the corresponding unprotected pipe. Several of the coatings afforded nearly complete protection to most of the sections of pipe to which they were applied, but no coating completely protected all sections.

Engineering principles.

The purpose of the test was to establish engineering principles related to the manufacture and use of protective coatings for pipe lines. The following are some of the facts established by the test.

1. Many of these coatings will reduce greatly corrosion during at least 10 years (the period of this test)—although complete protection from all corrosion has not been realized in corrosive and destructive soils.

2. The effectiveness of all coatings tested decreased throughout the period of the test. This in most cases is the result of continued soil pressure and the absorption of water. There appears to be little change in the coating materials other than the organic fabrics used as reinforcements or shields.

3. Shields and reinforcements should be permanent and sufficiently rigid to distribute soil stress and pressure due to the weight of the pipe over such areas as will avoid flow of the bituminous or other material used in the coating.

4. Thickness of material is an important factor in coating construction.

5. A coating should be sufficiently rigid to withstand pressures over long periods, and elastic enough to withstand stresses resulting from pipe movement and sudden changes in temperature. These requirements are difficult to reconcile.

6. A coating which fails to protect at a few points may cause, under certain conditions, deeper pits than would have occurred on uncoated pipe in the same location.

7. Many soils are only mildly corrosive, and no protective coating is required in them unless the cost of a leak is abnormally high.

8. The economics of the general problem should be considered.

Bibliography

1. Gordon N. Scott, "Progress Report No. 1: Installation of Test Coatings," Proc. A.P.I. 12 [IV] 55 (1931).
2. Gordon N. Scott, "Initial Inspection of Specimens," Proc. A.P.I. 12 [IV] 72 (1934).
3. Gordon N. Scott, "Second Inspection of Pipe-Coating Tests on Operating Lines," Proc. A.P.I. 13 [IV] 114 (1932).
4. Gordon N. Scott, "Third Inspection of Pipe-Coating Tests on Operating Lines and Second Inspection of Short Coated Specimens," Proc. A.P.I. 15 [IV] 18 (1934).
5. K. H. Logan, "Soil-Corrosion Studies, 1934: Bituminous Coatings for Underground Service," Natl. Bur. Standards J. Research 15, 695 (1937).
6. S. P. Ewing, Soil Corrosion and Pipe-Line Protection, Am. Gas Assoc., New York (1938).
7. Erick Larson, Pipe Corrosion and Coatings, American Gas Journal, New York (1938).
8. K. H. Logan and E. A. Koenig, "A Comparison of Methods for Estimating Soil Corrosivity," The Oil and Gas Journal, 38 [27] 130 (1939); also Proc. A.P.I. 20 [IV] 25 (1939).
9. Gordon N. Scott, "Adjustment of Soil-Corrosion Pit-Depth Measurements for Size of Sample," Proc. A.P.I. 14 [IV] 204 (1934).
10. K. H. Logan, "Engineering Significance of National Bureau of Standards Soil-Corrosion Data," Natl. Bur. Standards J. Research 22, 109 (1939).

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Use of Azeotropic Distillation

(Continued from Page 159)

From the data that are now available, the following conclusions may be drawn with regard to the fractionation obtainable by azeotropic distillation in rectifying columns of from 50 to 100 theoretical plates:

1. Aromatic hydrocarbons may be separated from naphthenes and paraffins with relative ease by one appropriate azeotropic distillation, in mixtures in which the aromatic hydrocarbons are ones that normally have boiling points not significantly less than the boiling points of the naphthenes and paraffins in the given mixtures.

2. Naphthene hydrocarbons may be separated from paraffins by several distillations with an appropriate azeotrope-forming substance, in mixtures in which the naphthene hydrocarbons are ones that normally have boiling points not significantly less than the boiling points of the paraffins in the given mixtures.

3. Aromatic hydrocarbons of different degrees of "aromaticity," as for example an alkyl benzene, an alkyl tetrahydronaphthalene, and an alkyl naphthalene, may be separated from one another, in mixtures in which the various aromatic hydrocarbons have substantially the same normal boiling points, or in which any differences in boiling point are of the same magnitude and sign as the differences in the boiling points of the corresponding binary azeotropic mixtures. Such separations may require one or more azeotropic distillations, depending upon the nature of the components of the mixture and its complexity.

4. Naphthene hydrocarbons having different numbers of naphthene rings may be separated from one another, in mixtures in which the various naphthene hydrocarbons have substantially the same normal boiling points, or in which the naphthenes with two rings are ones that have boiling points not significantly less than the boiling points of the naphthenes with one ring. Several azeotropic distillations usually will be required for the substantially complete separation of such compounds.

The actual production on a large scale of individual hydrocarbons, or groups of isomeric hydrocarbons, from petroleum or any of its products, by utilizing distillation in its several variations, will involve the following preliminary steps: (1) The determination of what compounds or groups of compounds are wanted; (2) the selection of a suitable source material for the given hydrocarbons, as a given crude petroleum or petroleums, or one or more of the products of the conventional refining process, or one or more of the products of the newer processes being utilized in the refining of petroleum to obtain special products; (3) the selection of the appropriate azeotrope-forming substances to be used, consideration being given to the composition of the azeotropic mixtures that will be produced, the initial cost of the azeotrope-forming substances, and the ease and completeness of its recovery from the azeotropic distillate.

Commercial Application of Azeotropic Distillation

A number of commercial applications of azetropic distillation already have been made. One example is the use of the benzene to obtain absolute ethyl alcohol from its minimum-boiling azeotropic mixture with water, which has the composition 95.6 per cent by weight of ethyl alcohol and 4.4 per cent by weight of water, and has a boiling point about 0.2° C. below that of pure ethyl alcohol.[13] In this case, benzene is used to break up an already existing binary azeotropic mixture through the formation of a ternary azeotropic mixture. When the quantity of benzene exceeds that required to remove all water as a component of the ternary azeotropic mixture, the products of distillation are, in order: (1) A ternary azeotropic mixture of benzene, ethyl alcohol, and water; (2) a binary azeotropic mixture of benzene and ethyl alcohol; and (3) ethyl alcohol alone. Another process for obtaining absolute ethyl alcohol by azeotropic distillation utilizes trichloroethylene as the azeotropic-forming substance.[15] In this latter case similar minimum-boiling ternary and binary azeotropes are formed.

Another application of azeotropic distillation is in the purification of commercial dioxane by removing the impurities of low-boiling aldehydes through the addition of water and a volatile inorganic acid, such as hydrochloric, hydrobromic, or sulfurous.[14] In this case it is reported that the low-boiling aldehydes are removed as a component of a minimum-boiling quaternary azeotropic mixture consisting of the aldehydes, water, the inorganic acid, and dioxane.

Conclusion

In the foregoing presentation no attempt has been made to go into the subject in any scientific detail, nor to suggest a solution for any specific problem in the refinery. The reader is referred to an extended paper on this subject by the authors[15] for details concerning the actual results obtained in the laboratory in separating aromatics from naphthenes and paraffins, naphthenes from paraffins, aromatic hydrocarbons of different degrees of "aromaticity," and naphthene hydrocarbons of different degrees of "naphthenicity." In this same paper are given a discussion of the benefits of distillation of the mixture of hydrocarbons at reduced pressure prior to their separation by azeotropic distillation, and also a list of the hydrocarbons known to be separable from petroleum by distillation alone.

Bibliography

1. J. Zawidsky, Z. physik. Chem. 35, 129 (1900).
2. H. A. Beatty and G. Calingaert, Ind. Eng. Chem. 26, 504 (1934).
3. C. B. Willingham and F. D. Rossini, to be published in J. Research Natl. Bur. Standards.
4. J. B. Ferguson, M. Freed, and A. C. Morris, J. Phys. Chem. 37, 87 (1933).
5. C. O. Tongberg and F. Johnston, Ind. Eng. Chem. 25, 733 (1933).
6. R. Fritzweiler and K. R. Dietrich, Angew. Chem. 46, 242 (1933).
7. J. H. Bruun and W. B. M. Faulconer, Ind. Eng. Chem., Anal. Ed. 9, 193 (1937).
8. M. Lecat, Bibliographie de L'Azeotropisme, Lamertin, Brussels (1932).
9. M. Lecat, Ann. soc. sci. Bruxelles 48B, Pt. 2, 105 (1928).
10. M. Lecat, Ann. soc. sci. Bruxelles 49B, Pt. 1, 28 (1929).
11. M. Lecat, Ann. soc. sci. Bruxelles 49B, Pt. 1, 119 (1929).
12. C. Ellis, The Chemistry of the Petroleum Derivatives, Vol. 2, Reinhold Publishing Corp., New York (1937).
13. E. Luhder, Z. Spiritusind 57, 252 (1934).
14. Haardt & Co., A.G., Brit. Pat. 442540 (1934); Chem. Abstracts 30, 4518 (1936).
15. B. J. Mair, A. R. Glasgow, Jr., and F. D. Rossini, to be published in J. Research Natl. Bur. Standards.

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BOOK REVIEW

GEOPHYSICAL PROSPECTING FOR OIL, by L. L. Nettleton, 444 pp., $5.00.*

This is an up-to-date discussion of practical geophysical methods, the theory upon which they are based, and their application in the field. As the author is in the research laboratories of a major oil company, he is fully aware of the needs of other members of the exploration staff and attempts to meet those needs. By far the greater part of the book is devoted to the three tried and proved methods: seismic, gravity, and magnetic. In each case, the author deals with fundamental principles, a description of the instruments used, and the theory on which they depend, the reduction of measurements, calculations, and interpretations, and a bibliography. Tables and graphs are numerous.

*"Geophysical Prospecting for Oil" may be purchased through the Book Department of The Oil and Gas Journal at the established retail price of $5, postage prepaid (extra outside of the United States), and a copy will be forwarded promptly upon receipt of check or money order for that sum. Where payment or company purchase order is not provided, the volumes will be sent c.o.d. to avoid delay.

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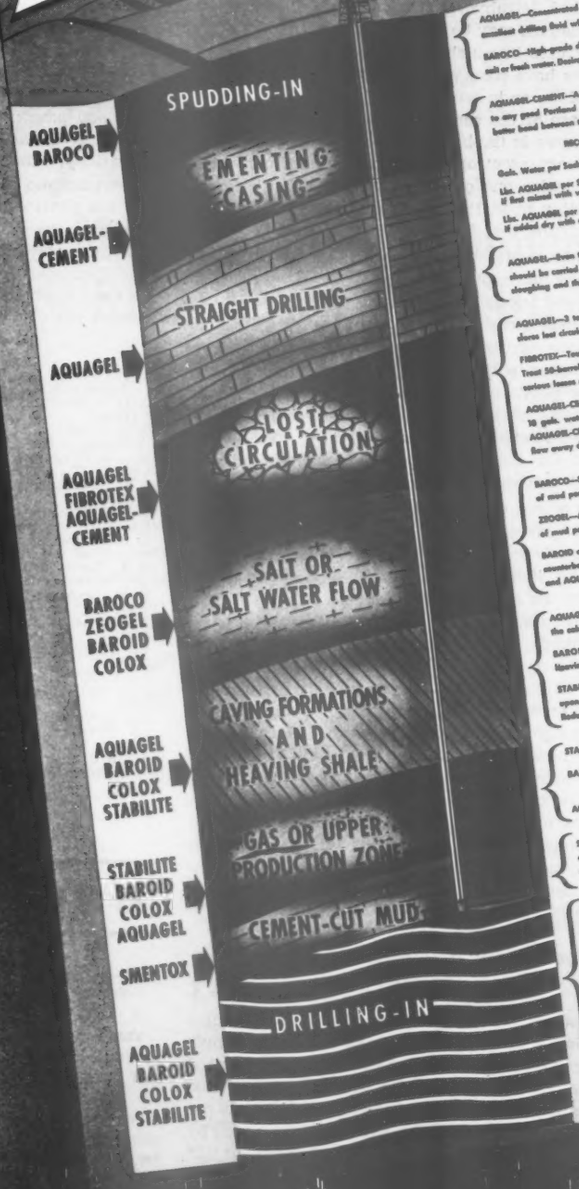


AQUAGEL—Concentrated colloidal gel-forming clay. One ton makes as many as 160 to 120 barrels of excellent drilling fluid when mixed with fresh water.

BAROCO—High-grade drilling clay. Makes about 40 barrels of drilling mud per ton when mixed with salt or fresh water. Desirable when mud becomes badly contaminated with salt because it resists flocculation.

AQUAGEL-CEMENT—A gel-type cement which may be formed by adding a small amount of AQUAGEL to any good Portland cement in either wet or dry state. Provides better formation shut-off by making a better bond between the casing and the hole.

RECOMMENDED AMOUNTS OF AQUAGEL TO BE USED IN CEMENT

Gals. Water per Sack Cement	5½	6	6½	7	7½	8	8½	9	9½	10
Lbs. AQUAGEL per Sack Cement if first mixed with water	9	1.3	1.6	2.0	2.2	2.6	2.9	3.3	3.5	3.8
Lbs. AQUAGEL per Sack Cement if added dry with cement	2	2½	3	3½	4	4½	5	5½	6	6½

AQUAGEL—Even though no definite formation troubles are encountered, a sufficient amount of AQUAGEL should be carried in the mud to keep the water loss low and the mud cake thin. High water loss induces sloughing and thick mud cake often causes stuck tools.

AQUAGEL—3 to 5% added to drilling mud, or 8 to 10% added to straight water often prevents or reduces lost circulation in loose formations. If this fails try FIBROTEX.

FIBROTEX—Tough fibrous material for preventing or restoring lost circulation in highly porous formations. Treat 50-barrel batches of mud with from 12 to 14 pounds per barrel. One to three batches often stops serious losses of circulation. If this is unsuccessful, use AQUAGEL-CEMENT.

AQUAGEL-CEMENT—To restore circulation in extremely fractured or cavernous formations use from 7 to 10 gals. water per sack of cement with from 2 to 6½ lbs. AQUAGEL per sack. (See schedule under AQUAGEL-CEMENT in CEMENTING CASING). Slurries of apparent high viscosity pump easily but do not flow away due to their gelling characteristics.

BAROCO—Salt resisting drilling clay. Maintains viscosity in the presence of salt. Makes about 40 barrels of mud per ton when mixed with salt water.

ZEOGEL—A concentrated colloidal clay which forms a gel with salt water. Yields upwards of 100 barrels of mud per ton in brine. Can be used where nothing but salt water is available.

BAROID or COLOX—Drilling mud weighting materials. Muds suitably weighted with BAROID or COLOX counterbalance pressure of salt water flows. Can be added to native mud or mixed straight with water and AQUAGEL.

AQUAGEL—Enough should be added to the mud to produce superior wall-building qualities and keep the cake thin. This will reduce greatly the tendency of formations to cave.

BAROID or COLOX—Suitably weighted muds have demonstrated their efficiency in holding caving or heaving formations in place.

STABILITE—There are several formulas of STABILITE, both liquid and dry, the choice of which depends upon the condition of and contaminating materials in the mud at the time treatment is required. Reduces viscosity and gel-strength and improves wetting qualities.

STABILITE—Reduces danger of blowouts by freeing entrained gas, thereby keeping mud weight constant.

BAROID or COLOX—Highly weighted muds are frequently necessary in caution gas or other pressures.

AQUAGEL—Sufficient should be carried in all muds to keep the water loss low and the cake thin.

SMENTOX—When drilling ahead after a cement job, the use of SMENTOX counteracts the effects of cement on mud. A small amount added to mud after a cement job will often eliminate the necessity of dismantling the mud. Viscosity is reduced and wall-building qualities restored.

AQUAGEL—In Low-Pressure Areas—Straight AQUAGEL-water mud (5½% to 7% by weight depending upon the mixing water used) is the ideal mud for drilling in. The low water loss keeps water from the oil sands and the thin cake is quickly and easily removed. Wells drilled in with this field muds on production and clean up quicker.

BAROID or COLOX—In High-Pressure Areas—A combination of BAROID or COLOX and AQUAGEL muds up to suitable weight is the ideal drilling fluid. In locations where the natural mud provides adequate wall-building qualities BAROID or COLOX added to the mud in sufficient quantities will provide adequate weight to insure safety.

STABILITE—If gas cutting of the mud occurs, add suitable quantities of STABILITE in either liquid or powdered form.

OIL WELL DRILLING MUD SERVICE BAROID

QUESTIONS ON TECHNOLOGY

By W. L. NELSON, TECHNICAL EDITOR

Scaling of Tubes When Firing High-Sulfur Oil

I should appreciate your opinion on the corrosive effect of sulfur containing fuel oil on the external surface of pipe still (tubes) used in cracking processes, particularly at radiant section. How does the rate of corrosion due to sulfur compare with that of air or moisture under the same temperature conditions?—J. E. B.

The effect of different furnace atmospheres on the rate of scaling is clearly recognized throughout the industry. The three main furnace conditions are those of oxidation, sulfidization and carburization. Plain oxidation is the condition that normally exists in a furnace that is fired with a low-sulfur fuel and with an ample amount of excess air so that little or no carbon monoxide is produced. Any of the alloys indicated in the tabluation which follows are suitable for oxidation conditions providing the temperature is not excessive and the strength is adequate. Should the fuel contain more than about 1 per cent of sulfur, the chromium-nickel steels are conceded to be superior whereas for carburizing conditions the nickel-chromium (nickel predominates) are preferable. Carburizing or reducing conditions arise if insufficient air is employed or if a hot gas that is high in carbon monoxide or hydrocarbon gases is in contact with the tubes. The temperatures at which scaling becomes pronounced is shown in the tabulation for the three furnace atmospheres.

	Composition		Approximate scaling temperature °F.		
	% Cr	% Ni	Oxidizing	Reducing	Sulfidizing
Plain chromium steels	13	..	1,400	1,100	
	18	..	1,500	1,300	1,300
	23	..	1,800	1,500	1,500
	28	..	2,100	1,700	1,700
Chromium-nickel steels	18	8	1,600	1,300	1,600
	24	12	2,000	1,900	2,000
	28	10	2,100	1,900	2,000
	25	20	2,100	2,000	2,100
Nickel-chromium steels	15	65	1,800	2,100	....
	15	35	1,900	2,000	....
	20	25	2,000	2,000	....

The rate at which scaling takes place under the various conditions has not been extensively studied. It is probably safe, however, to assume that normally thick tubes of the steels listed above will last for 5 or more years if the scaling temperatures are not exceeded.

Petroleum and Synthetic Rubber

Will appreciate information on synthetic rubber, particularly as affects the oil and gas content therein?—W. J. B.

You may be laboring under a misapprehension. Synthetic rubber contains no oil or gas as such, although oil and gas may have been used in its manufacture by converting the oil or gas into entirely new materials.

The synthetic rubbers are obtained in a general way from certain hydrocarbons sometimes used along with certain other agents such as organic oxygen, nitrogen, chlorine or sulfur compounds. The basic hydrocarbons most frequently mentioned are butadiene, isoprene, styrene, and isobutylene, as well as other little known hydrocarbons that are found in cracked gasoline. The basic hydrocarbons just mentioned are not found in natural gas or crude petroleum, except perhaps in minute amounts, but they can be made from other hydrocarbons that are found in gas or oil. Thus, the ethane and butane found in natural gas may be sent through a chain of chemical reactions to make the basic hydrocarbons.

Likewise, when certain parts of a crude oil are subjected to cracking (thermal decomposition), gases such as ethylene, butylenes, etc., are produced which also may be changed into the basic hydrocarbons by chemical means. The petroleum industry is not the only source of the basic hydrocarbons because they can be obtained from coal, wood, vegetable matter, etc., and in fact from almost any carbon hydrogen material.

The position of natural gas and petroleum with respect to synthetic rubber, is merely that of a raw stock. The processing by which rubber is made is so complicated that it cannot be contemplated as a commercial venture except by the largest industrial chemical companies of which the large refiners or rubber manufacturers are examples.

The development of synthetic rubbers is in such a state of flux that I suggest that you refer to articles such as those published in The Oil and Gas Journal issues of April 11, 1940, Page 9, and June 13, 1940, Page 25; and also the recent Bureau of Standards Circular C427 (1940), entitled "Synthetic Rubbers . . . ," which may be obtained from the Superintendent of Documents, Washington, D. C., for 10 cents.

Simplified Flow Diagrams

Combination Cracking Unit

The diagrams of combination cracking units that are found in magazines are so complicated that we are confused as to the real meaning of such a process. Can you define a combination process for us?—V. K.

The name "combination cracking unit" has been used very loosely and probably cannot be defined in a simple way. Such a process can, however, be made clear by a discussion providing the general principles of cracking and related processes are already understood. Nor can a simple diagram be presented, because a combination process is a combination of many operations conducted simultaneously.

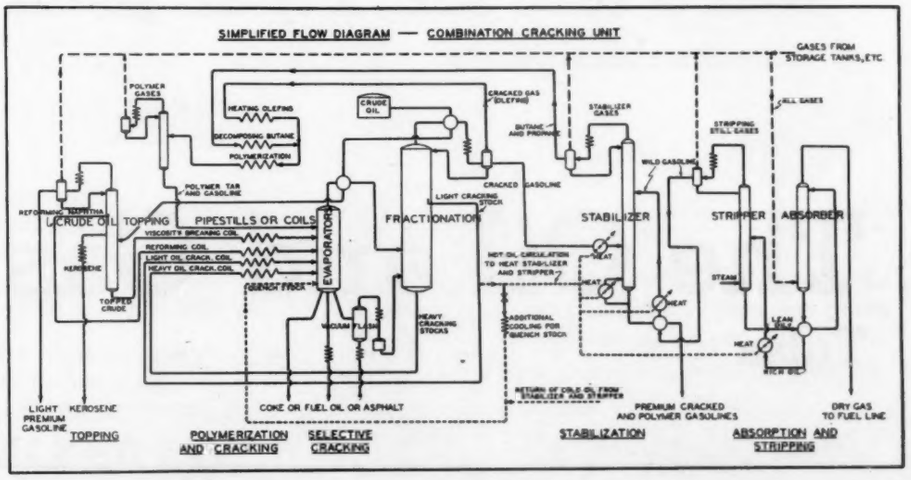
The development of cracking plants which comprise a combination of processes is due directly to the advantages of cracking selected stocks each at its most suitable conditions, the large amount of heat that is available in cracking plants, and the general similarity of such operations as cracking, viscosity breaking, reforming, coking and even polymerization. Some of the operations that have been advantageously combined are:

(1) Crude oil topping. (2) Viscosity breaking. (3) Reforming of naphtha. (4) Selective cracking of several stocks. (5) Coking. (6) Vacuum flashing. (7) Gasoline recovery from cracked gas. (8) Polymerization of cracked gas. (9) Stabilization of gasoline distillates.

The similarity of Operations 2, 3, and 4 permits a single evaporator to be used for all three operations. In each of these processes the cracked stock must be currently freed from cracked tar if coking of the tubes is to be avoided. Thus, in the diagram shown on this page, all cracked stocks are led to a common evaporator and the several recycle stocks are separated from one another in a single major fractionating tower system. If coking is advisable, the evaporator can be replaced by coking chambers.

Note also that all gases, i.e., cracked, polymer, and even plant gases, may be processed in a single absorption, stripping and stabilizing system.

From the above and an inspection of the flow diagram, it is apparent that many arrangements are possible. Some of these will not include all of the operations mentioned above, and others may be even more complicated due to the use of several vessels for the single ones shown in the diagram.



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Pipe-Line Activity

Latex Lays Gas Line for United at Abbeville, La.

HOUSTON, Tex.—Latex Construction Co. is laying approximately 12 miles of 8-in. gas line for United Gas Pipe Line Co. from the Abbeville field, Vermilion Parish, Louisiana Gulf Coast, to tie into the latter company's main South Louisiana gas system at a point about 12 miles west of the town of Abbeville. The line will furnish an outlet for gas produced by Continental Oil Co. in the Abbeville field.

Work Progresses on Wilson Creek-Craig Pipe Line

DENVER, Colo.—Work is approximately 50 per cent complete on the Wilson Creek-Craig, Colo., pipe line being laid by the Texas Co. and the California Co. to connect the companies' producing properties in the Rio Blanco County, western Colorado, pool with the Texas refinery at Craig. The line, a 4-in. welded carrier, is some 20 miles in length and ties in the Wilson Creek field with the Texas Co.'s main carrier from the Iles Dome field to Craig.

Operators expect to have the work completed and the line in service by the close of this month, remaining construction work being located in the Axial basin valley area. At the present time, crude from the Wilson Creek pool is trucked to the Craig plant for processing.

Compressor Units Are Added To Colorado Gas Systems

DENVER, Colo.—The Canadian River and Colorado Interstate Gas companies are adding eight new compressor units on their natural-gas pipe line from the Texas Panhandle to Denver and other Colorado cities to increase capacity. The improvements are to be finished by January 1, 1941, and are expected to increase capacity by about 20 per cent. The line was originally designed for 105,000,000 cu. ft., maximum capacity in 24 hours.

The demand for gas has about taxed the line to its present capacity and for some time the operating companies have been investigating various proposals for augmenting the supply. These are said to have included the possibility of additional construction, but these plans were deferred in favor of installing greater compressor capacity. Last winter it became necessary during extreme cold periods to curtail service to some industries in order to meet the peak demand for domestic uses.

Five of the new units are being installed at the Dalhart, Tex., station by the Canadian River Gas Co., which transports the gas from the field to the Texas-New Mexico line near Clayton, N. M. One unit is under construction at the Canyon station east of Trinidad and two at the Devine station east of Pueblo, the latter being constructed by the Colorado Interstate Gas Co., which operates the line from Clayton to Denver.

This information was brought out in the testimony of Robert W. Hendee, operating manager of the two companies, in the hearings in progress at Denver before Examiner Norman B. Gray, of the Federa. Power Commission. The hearings were adjourned a few days before election and will be resumed next week. Testimony so far presented mostly concerned the ownership of the various operating units of the system.

Gas Line Is Considered In West Central Texas

FORT WORTH, Tex.—A gas line was reported under consideration in western Shackelford County, West Central Texas. The proposed line would be from the recently opened gas reserve in extreme northwestern Shackelford County to the Bluff Creek field in the west-central part of the county. Gas would be used for repressuring purposes in this now declining field. Definite plans are pending decision as to whether the yet undetermined gas reserve would prove sufficient for the secondary-recovery project.

The first gas well in the area was Forest Development Corp. and P. S. Kendrick No. 1 Hendrick which made about 8,000,000 cu. ft. daily. A short time ago the second well was brought in for about the same volume and located 2,000 ft. to the southeast. Definite plans for either the pipe line or the development of the gas field, have not yet been announced.

Williams Brothers Lays Line For Pacific Gas & Electric

Williams Brothers Corp. has laid more than 33,000 ft. of pipe for a 19-mile line under construction between Lodi and Rio Vista, Calif. Work is being carried on under the direction of William Humphreys, superintendent for the contractor. At the present time Williams Brothers Corp. has 15 gangs at work in various parts of the United States on pipe-line construction projects.

Magnolia Runs Oil Through New Line

WICHITA FALLS, Tex.—Magnolia Pipe Line Co. made its initial run of oil last week through its new 8-in. welded line from the main station north of Ringgold to the Hull-Silk pool. The carrier is hooked into 180 wells and taking 5,278 bbl. daily from the pool. The line for Magnolia was contracted by T. R Jones.

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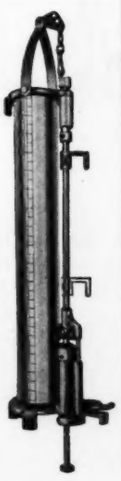

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FIELD DEVELOPMENTS...

HIGHLIGHTS FROM THE WEEK'S NEWS—

OKLAHOMA: A Wilcox sand pool was found in Seminole County, between the East Earlsboro and Mission areas. A highly regarded wildcat in Caddo County proved the big disappointment of the week when salt water intruded. The Dill pool, Okfuskee County, was extended northeastward. The Coyle pool, Payne County, was defined on the north.

KANSAS: A chat pool apparently was found near Roxbury, northeastern McPherson County. A Graham County wildcat found oil in an area 22 miles from nearest production. The Prusa pool, Barton County, was extended ½ mile eastward. The Orth pool, Rice County, was extended 1 mile northward.

TEXAS GULF COAST: Another new field promised for Galveston Bay, as preparations made to test wildcat on Fishers Reef prospect. Outpost well on north edge of Ogburn field cores deeper sand.

SOUTHWEST TEXAS: Oil production extended on east flank Agua Dulce field, Nueces County. Weser area, Goliad County, in limelight as drill-stem test in Cook Mountain recovers pipe-line oil.

WEST TEXAS: Production gages were in progress at the close of the week at the deep Simpson lime field discovery in northern Pecos County by Taubert-McKee-Siemoneit 1 Crockett. A small shallow discovery was testing, also, in northern Pecos.

NORTH TEXAS: New wildcat locations have pushed the drilling program of the Fort Worth basin to the edge of the city of Fort Worth. Deep exploratory holes are starting 5 miles north of the city and also southwest of the city in Hood County.

LOUISIANA GULF COAST: New field promised Westwego area west of New Orleans, Jefferson Parish, as deep test tries to blow out.

EAST TEXAS: Limestone County is making a strong bid for major importance from the deep lower Trinity zones along the old Balcones fault-system trend. One new field has been opened, a wildcat is preparing to test, and another is preparing to start. The objective is the Travis Peak formation.

SOUTHEAST NEW MEXICO: The area southeast of the Loco Hills field in Eddy County is undergoing a thorough development program as new proven acreage is added with almost every well completed. The area embraces the Ginsberg field, the Shugart field, and the Kersey Creek field.

ARK-LA-TEX: Deep development in Lisbon is slowed up by two deep failures, although a third well found production in the Travis Peak.

MICHIGAN: After reporting three light wells, the Adams field yielded another good producer this week when a 1,620-bbl. well was completed.

CALIFORNIA: Tupman and the Coalinga district with over 30 active operations are the liveliest areas in California at present. Paloma gets a good completion and an interesting downstructure test is staked.

COMPLETIONS IN ALL FIELDS . . .

(Week Ended November 9, 1940)

	Oil	Gas	Dry	Total	1940 total comp. to date	1939 total comp. to date
N. Y., Pa., and W. Va.	68	27	3	98	5,279	3,102
Ohio	7	20	9	36	1,038	728
Indiana	7	1	3	11	412	293
Kentucky	6	0	6	12	436	607
Illinois	59	0	18	77	3,311	3,099
Michigan	9	2	13	24	1,026	1,269
Kansas	31	2	11	44	1,548	1,138
Oklahoma	29	4	12	45	1,573	1,501
Texas:						
North Central Texas	46	0	25	71	2,508	2,085
West Texas	23	0	1	24	1,577	1,583
Texas Panhandle	1	2	1	4	508	373
Eastern Texas	9	1	2	12	542	617
Gulf Coast Texas	19	0	2	21	1,077	1,160
Southwest Texas	25	0	8	33	1,819	2,097
Total Texas	123	3	39	165	8,031	7,915
North Louisiana	14	1	2	17	560	465
Louisiana Gulf Coast	10	0	3	13	884	619
Total Louisiana	24	1	5	30	1,344	1,084
Arkansas	1	0	0	1	159	217
Montana	3	3	0	6	201	146
Wyoming	1	0	1	2	141	117
Colorado	0	0	0	0	13	20
New Mexico	7	0	2	9	479	499
California	21	0	4	25	887	788
Miscellaneous	4	0	3	7	206	56
Total United States	399	63	129	591	26,780	22,737
Total previous week	405	67	125	597		
Week ended Nov. 13, 1939	368	41	118	527		

SUMMARY OF OUTSTANDING FIELDS . . .

(Week Ended November 9, 1940)

	Active operations	Oil completions	Initial prod.	Total No. oil wells	Daily av. prod.
TEXAS:					
K.M.A.	52	8	4,013	1,504	35,281
Wasson	39	4	2,785	986	32,465
Ector County	48	8	6,237	2,336	44,850
Hull-Silk	42	3	2,739	380	10,273
East Texas	18	5	200	25,921	374,850
OKLAHOMA:					
Cumberland	11	0	0	9	3,000
Hewitt	22	6	1,730	779	5,325
KANSAS:					
Bornholdt	9	2	397	135	3,125
Stoltenberg-Wilkins	15	2	1,105	161	3,315
Silica	8	1	350	715	11,900
Trapp	7	4	1,570	589	11,050
ARK-LA-TEX:					
Olla	9	5	745	61	6,305
Cotton Valley	4	1	545	160	15,525
MICHIGAN:					
Adams	10	1	1,620	22	1,882
ILLINOIS:					
Salem	7	2	320	2,950	136,600
Louden	34	8	825	1,106	69,150
Centralia	3	0	0	717	18,000
Other basin fields	371	49	9,363	2,654	109,900
Old fields	....	....	.....	.....	10,750
NEW MEXICO:					
Lea County	47	4	1,323	2,588	85,770
Eddy County	46	3	445	632	17,380
MISSISSIPPI:					
Tinsley	9	3	1,263	90	15,400

Two Deep Failures Recorded In Travis Peak at Lisbon

By
GEORGE WEBER

SHREVEPORT, La., Nov. 11.—Deep tests in the Lisbon and Haynesville fields of Claiborne Parish, Louisiana, were watched with interest this week, but developments of importance were few. Failures in two Lisbon tests which were deepened from the Pettit to the Travis Peak, dampened interest in the deeper producing horizon. Completion of one upper Travis Peak or Hosston well, and anticipated testing of deeper horizons in a deep wildcat now fishing sustained interest in the field, however.

Oakes, Caruthers and Morelock Whitman No. 1, a southwest Lisbon producer, deepened to the Hosston to explore an oil horizon previously shown in a nearby test, was completed for an initial production of 81 bbl. of 40-gravity sweet oil through a ¼-in. choke. The test has been cleaning for several days, after mud, pumped into the hole to kill a blowout, clogged the producing sand. This is the first completion in the new deeper horizon, but discovery of the new level must be credited to the Caruthers, trustee, 1 Simmons unit, located to the southeast. The latter test encountered the horizon, showing 17 ft. of oil sand in the transitional zone in the top of the Hosston or Travis Peak formation. Completion was not attempted, as the test was contracted for a greater depth. Further oil shows in the Cotton Valley formation have been encountered by the Simmons Unit No. 1, and a blowout threatened in a sand at 8,676 ft. resulted in operators sticking drill stem while killing the well. Fishing operations are still under way.

In nearby Haynesville, Ohio Oil Co.'s 15 Taylor is below 11,130 ft. in lime and shale after topping what is believed to be the Smackover lime at 10,891 ft. where a slight show of gas was reported.

Southwest of Lisbon and due west of Sugar Creek, the V. A. Hardin 1 Valentine, wildcat, is still shut down with 5½-in. casing set at 6,430 ft. and total depth at 6,507 ft. Sands at 6,157-70 ft., 6,213-31 ft. and 6,317-32 ft. show production possibilities and may be tested soon.

Estimated Daily Production

Estimated daily gross production week ended November 8:

NORTH LOUISIANA

	Barrels
Bellevue	480
Caddo light	5,750
Caddo heavy	2,185
Converse	500
Cotton Valley	*13,525
Cross Lake	3,455
De Soto and Red River	980
Elm Grove	330
Haynesville	2,725
Holly	95
Homer	2,820
Lisbon	3,125
Nebo	300
Olla	6,305
Pleasant Hill	90
Rodessa	17,485
Sarepta-Carterville	†275
Sligo	2,255
Sugar Creek	490
Urania	2,410
Zwolle	1,460
Total North Louisiana	67,040

SOUTH ARKANSAS

Atlanta	2,430
Big Creek	120
Buckner	1,910
Champagnolle	1,130
Dorcheat	1,100
El Dorado	1,640
Fouke	255
Lewisville	475
Lisbon	210
Magnolia	19,600
McKamie	410
Miller County	260
Nevada	570
Nick Springs	775
Rodessa	1,750
Schuler	17,100
Smackover light	1,600
Smackover heavy	13,630
Stephens	555
Troy	1,115
Urbana	1,700
Village	1,040
Total South Arkansas	69,375
Rodessa, Texas, 17,240 bbl.	

*3,650 bbl. is distillate.
†41 bbl. is distillate.

La Salle Activity

Olla drilling continues strong, with five new wells brought in during the past week and nine rigs operating in the field. Drilling has begun on the offset to the Summerville field discovery well to the south, and with the fourth well due in on the west edge of the Nebo field, a fifth location has been staked one location further west.

Other operations in the lower Wilcox play are active in Catahoula, Franklin, Grant and La Salle parishes. A new wildcat, Gholson & Hodge 1 Eberlee has been staked southwest of the Nebo field in Grant Parish.

In western Caddo Parish, the Delta Drilling Co. has staked location for 1 Dunn, a wildcat near Greenwood. Another interesting Caddo Parish test is Great National Oil Co. 1 Means, drilling east of the Rodessa field near Ida.

NORTH LOUISIANA COMPLETIONS

Bellevue—Bossier Parish

Tide Water G. O. 4 Lodwick . . . . . SE SW 10-19-11
T.D. 416 ft., 4½-in. casing 397 ft., completed as injection well.

Sligo—Bossier Parish

Triangle Drlg. Co. 4 Chatman . . . . . NW SE 18-17-11
400 bbl., ½-in. choke, T.P. 100 lb., C.P. 400 lb., top porous lime 3,108 ft., T.D. 3,115 ft., set 5½-in. casing 3,108 ft.

Caddo—Caddo Parish

Blalock & Strange 1 Noel Est. . . . SW NW SW 15-20-15
Dry, T.D. 2,210 ft.
Gulf 16 Tyson . . . . . NW NE SW 14-21-15
320 bbl., open tubing, 4,000 gal. acid, T.D. 1,697 ft.
La. Oil Prod. Co. 5-D Muslow . . . . NW NW SE 5-20-15
Pumping 105 bbl., T.D. 1,504 ft., 4,000 gal. acid.
E. W. McGoldrick 10 Muslow . . . . SE SW SW 32-21-15
Pumping 50 bbl., 4,000 gal. acid, T.D. 1,515 ft., 6⅝-in. casing 1,394 ft.
Midfield 3-C Muslow . . . . . NE NW NW 5-20-15
Pumping 140 bbl., 4,000 gal. acid., T.D. 1,516 ft., 7-in. casing 1,398 ft.
Red Bank Oil Co. 1 Woolbert . . . NW SW SW 26-21-15
Pumping 5 bbl., 6⅝-in. casing 1,438 ft., 4,000 gal. acid, T.D. 1,520 ft.
Tyson & Dodd 3 Muslow . . . . . NW SE NE 31-21-15
Pumping 40 bbl., 6⅝-in. casing 1,451 ft., 4,000 gal. acid, T.D. 1,595 ft.

Lisbon—Claiborne Parish

T. L. James 1 Lowery . . . . . NE NW 14-20-5
Old well drilled deeper, old T.D. 5,327 ft., drilled to 5,522 ft., top Travis Peak 5,397 ft., dry.
Oakes, Caruthers & Morelock 1 Whitman . . . . . SW NW 2-20-5
81 bbl., ¼-in. choke, T.P. 620 lb., C.P. 800 lb., T.D. 5,428 ft., old well drilled deeper, old T.D. 5,277 ft., top Travis Peak 5,352 ft., Travis Peak sand 5,400-07 ft.
Olson Drlg. Co. 1-A Patton Est. . . S½ NW SW 30-21-4
Old well drilled deeper, old T.D. 5,172 ft., drilled to 5,743 ft., top Travis Peak 5,304 ft., salt water, completed as gas injection well in Pettit 5,172 ft.

Wildcat—De Soto Parish

R. C. Swayles 1 Jackson . . . . SE NW SW 36-12-14
T.D. 2,078 ft., top Blossom 2,063 ft., dry.

Wildcat—La Salle Parish

Hope & Thompson 1 La. Central . . . . SW SW 25-11-2e
T.D. 3,918 ft., dry, top Wilcox 1,580 ft., top Midway 3,884 ft.

Olla—La Salle Parish

H. L. Hunt 2 Urania . . . . . SE SW 25-10-2
160 bbl., 3 per cent salt water, 12/64-in. choke, T.P. 500 lb., C.P. 600 lb., 7-in. casing 2,379 ft., perf. 2,204-10 ft., Cruse sand, T.D. 2,380 ft.
Placid 1 A. H. Hopkins unit . . . . . NE SE 24-10-2e
240 bbl., 8 per cent salt water, ¼-in. choke, T.P. 150 lb., C.P. 1,750 lb., 7-in. casing 2,384 ft., perf. 2,198-2,204 ft., Mathews sand, T.D. 2,384 ft.
Placid 38 La. Central . . . . . SE NE 36-10-2
144 bbl., 8 per cent salt water, 12/64-in. choke, T.P. 275 lb., C.P. 575 lb., 7-in. casing 2,399 ft., perf. 2,238-43 ft., Mathews sand, T.D. 2,400 ft.
Placid 50 La. Central . . . . . NE SE 35-10-2e
Heading 85 bbl., 1 per cent salt water, ½-in. choke, T.P. 50 lb., C.P. 150 lb., 7-in. casing 2,425 ft., perf. 2,246-54 ft., Mathews sand, T.D. 2,425 ft.
Placid 57 La. Central . . . . . NW SE 35-10-2e
144 bbl., 37 per cent salt water, 12/64-in. choke, T.P. 100 lb., C.P. 240 lb., 7-in. casing 2,401 ft., perf. 2,230-36 ft., lower Central sand, T.D. 2,402 ft.

Monroe—Ouachita Parish

United Carbon Co. 6 Spades fee 6-18-4e
7,000,000 cu. ft., R.P. 625 lb., T.D. 2,141 ft.

Converse—Sabine Parish

J. D. Haynes 2 Frost Lumber Ind. . . . NE SW 17-9-13
Pumping 30 bbl., 6-in. casing 1,500 ft., T.D. 1,630 ft.

Cotton Valley—Webster Parish

Hunt Oil Co. 2 Jordan . . . . . NE SW NE 31-21-10
576 bbl., ⅝-in. choke, T.P. 500 lb., C.P. 1,200 lb., "D" sand 8,474-97 ft., 7-in. casing 8,642 ft., perf. 8,476-87 ft., T.D. 8,645 ft.

NORTH LOUISIANA FIRST REPORTS

Wildcat—Bossier Parish

Ed D'Armand 1 Elgin . . . . . NW SW SE 8-20-13

Caddo—Caddo Parish

J. W. Bailey 1 Muslow . . . . . SE NE SW 32-21-15
J. W. Bailey 2 Muslow . . . . . SW NE SW 32-21-15
Butler Prod. Co. 1 Williams . . . . NE NE NW 24-22-16
Gulf 271 Caddo Levee Board . . . . C W½ E½ 16-20-16
Lydia Johnson 1 Lavine Murray . . NW NE NE 12-20-16
La. Oil Prod. Co. . . . . NE NW SE 5-20-15
Magnolia 30 Doan-Thigpen . . . . . NE NW NE 6-20-15
Midfield Oil Co 1-C Muslow . . . . . NE NE NW 5-20-15
Texas Co. 12 Mabry . . . . . NE NE SE 15-21-15
Tippett Oil Corp. 3 Browning . . NW SW SW 22-22-16

Wildcat—Caddo Parish

Delta Drlg. Co. 1 Dunn . . . . . NW NE NW 24-17-16

Georgetown—Grant Parish

R. D. Bevil 2 Swope . . . . . SE SE SE 18-9-1e

Wildcat—Grant Parish

Gholson & Hodge 1 Eberlee . . . . . NE NE 16-7-1e

Olla—La Salle Parish

Arkansas Fuel Oil 1-B Cruse . . . . . SE SW 19-10-3e
Placid 2 A. H. Hopkins . . . . . NW SE 24-10-2e
Placid 73 La. Central . . . . . NE SE 2-9-2e

Nebo—La Salle Parish

H. L. Hunt 5-A Goodpine . . . . . NW SW 9-7-3e

Zwolle—Sabine Parish

A. R. Bollinger 1 Long Bell . . . . NE NE NE 18-8-13

Monroe—Union Parish

Nemours Corp. 1 Edwards . . . . . NW SE 36-22-3e

Cotton Valley—Webster Parish

Hunt Oil Co. 1 Crichton . . . . . NE NW 31-21-10

NORTH LOUISIANA WILDCATS

Bossier Parish

Roy L. Reese et al 1 Bellevue Land Co. . . . . SW SW NE 27-20-11
T.D. 3,035 ft., ran electrical log and S.D.

Catahoula Parish

Continental Oil Co. 1 Tensas . . . N½ SW SW 12-9-7e
Old well drilled deeper, old T.D. 9,215 ft., washed out to 4,900 ft., arranging take side-wall cores.
Sinclair Prairie 1 Peck, 1,200 ft. N, 250 ft. E S cor. irregular 39-10-8e, drilling 4,300 ft., top Wilcox 3,110 ft.

Claiborne Parish

J. D. Caruthers, Tr. 1 Simmons unit . . N½ SW 2-20-5w
(Deep Lisbon), fishing drill stem 8,689 ft.
V. A. Hardin et al 1 Valentine . . . . NW NW 31-20-6w
Set 5½-in. casing 6,430 ft., T.D. 6,507 ft., awaiting orders.
Ohio Oil Co. 15 Taylor . . . . . NE SW SE 15-23-8
(Deep Haynesville), top Smackover lime 10,891 ft., drilling 11,115 ft.
Union Prod. Co. 1-A Meadows et al . . . . C NE 18-21-4
Coring lime 9,144 ft.

De Soto Parish

J. E. Stack et al 1 Cook . . . . . NW NE 32-13-14
S.D. 365 ft.

Franklin Parish

H. L. Hunt 3 Chicago Mill & Lbr. Co. . SW SE 35-14-9e
Drilling sand 2,567 ft., top Wilcox 2,512 ft.

Grant Parish

Speir & Nance 1 Armstrong . . . . SW NE NE 27-9n-1e
Set 10-in. casing 37 ft.

La Salle Parish

Delta Drlg. Co. 1 Hughes . . . . . NE NE SW 22-8-1e
Losing returns 320 ft.

Sabine Parish

Roy Raines 1 Carter . . . . . SW NW NW 27-9-11
Set 6⅝-in. casing 2,025 ft., waiting on cement.

Union Parish

Tiki Exploration Co. 1 Jones . . . . SE SE NW 30-21-3w
Tested salt water 2,100 ft., old T.D. 3,200 ft., S.D.

ARKANSAS

A small oil well may be completed in wildcat territory in southern Clark County as a result of showings in Coker Oil Corp. 1 Guess, 2-11-20, about 20 miles north of Troy. The shallow operation has bailed 10 bbl. of fluid of which 1 bbl. was 10-gravity oil, and a pumping unit may be installed. United States Oil Co. 1 Wilford, a wildcat, is drilling below surface casing in St. Francis County.

ARKANSAS FIRST REPORTS

Urbana—Union County

Marine Oil Co. 8-B Thompson . . . . NE SE SW 3-18-13

(Continued on Page 230)

By

L. P. STOCKMAN

Tupman and Coalinga Areas Are Most Active in Valley

LOS ANGELES, Nov. 11. — Crude-oil production in California during the early part of November was averaging about 18,000 bbl. per day below the same period in October and if this improvement continues actual production for the month of November will drop below 600,000 bbl. per day. Current daily production of leading California fields for the past week follows:

	Barrels
Wilmington	81,050
Midway-Sunset	54,800
Long Beach	43,825
Kettleman North Dome	37,725
Ventura Avenue	33,750
Coalinga	31,500
Huntington Beach	26,250
Dominguez	21,200
Santa Maria Valley	18,100

SAN JOAQUIN VALLEY

Approximately 15 new wells are scheduled for completion in the Northeast and Southeast Coalinga fields between now and the close of the current year. During the past week three new wells were finished in the Northeast Coalinga field and one new well was put on production in the Southeast Coalinga field. There are at the present time five incompleted drilling wells making hole below 8,000 ft.; three drilling between 7,000 and 8,000 ft., five between 6,000 and 7,000 ft. and five above 6,000 ft. Derricks are standing for seven additional wells. Developments in the south end of the Northeast Coalinga and north of the Southeast Coalinga field have not been especially favorable during the past month or two as the sand appears to pinch out or contains little oil and as a consequence operators are having difficulty completing normal producers. In 30-19-16, Pure Oil Co. has suspended 1 East Coalinga Subdivision at 8,397 ft. due to absence of the Gatchell sand. George F. Getty and Pacific Western 1 Goodell found such a poor-looking oil sand that the hole is being whipstocked in the hope of finding better saturation to the east.

Tupman—Coles Levee

Richfield Oil Corp. continues to pursue an aggressive drilling program in the Tupman and Coles Levee fields and at present is running 16 strings of tools. Most of these incompleted drilling projects are located in the Tupman field where the company has proved up a reserve of substantial proportions. Most of this drilling is being done under contract with Richfield furnishing surface equipment, tanks, traps and other production equipment. All casing, tubing and liners are also furnished by the company. Drilling contractors handling work for Richfield Oil Corp. in this area include Bell & Loffland, T. P. Pike Drilling Co., J. E. Mabee Co. and Taft Well Drilling Co. There are at the present time 19 drilling wells in these fields of which Richfield Oil Corp. is drilling 16, Ohio Oil Co. 2 and Standard Oil Co. 1. Of this group, 10 are making hole below 9,000 ft., three are between 8,000 and 9,000 ft., two are between 6,000 and 7,000 ft. and four are above 5,000 ft. It has been quite well established that Tupman and Coles Levee are two separate accumulations although for some time it appeared that this might be one large field. These fields are located east of the Elk Hills field and on the bifurcated axis of that field, one branch of which swings north and the other to the south. To date the Tupman field is by far the most productive and should reach primary importance from a production standpoint.

Paloma—Wasco

Western Gulf Oil Co. is putting the finishing touches on 34-2 Kern County Land in 2-32s-26e at Paloma and should have this well tanking oil within the next few days. On a formation test early in the week at 10,282-448 ft. with a 997-ft. water cushion and open 2 hours and 21 minutes the well flowed at a daily rate of 692 bbl. of very clean 47.8-gravity oil and and 2,500,000 cu. ft. of gas through a ⅝-in. bean. A 7-in. water string is cemented at 10,282 ft. and connections are being made preparatory to completion. Southeast of this well the company has started drilling operations on 12-12-B Kern County Land in 12-32s-26e but it will probably be some time early in the new year before the critical depth is reached. This outpost is being drilled down structure in the hope that a normal black oil will be found outside the gas cap area. If a black oil is found it will mean that the Paloma field will be a district of primary importance because the gas-cap area is already proved up for a distance of about 1 mile along the axis. In the Wasco field of Kern County, Pacific Western Oil Co. is still working on 1 Meyer in 7-27s-24e but still has some distance to go before reaching the pay. This outpost was drilled to 13,150 ft. but missed the pay and necessitated a redrill job. The crew is now redrilling at 12,129 ft.

SAN JOAQUIN VALLEY COMPLETIONS

Blackwell's Corner District

Seaboard 66-17 Beer 17-26s-19e
Abandoned drilling 8,821 ft. in Moreno (Cretaceous) hard gray shale. Formation test 7,062-449 ft. open 45 minutes recovered 1,350 ft. salt water and small amount of gas. Abandoned as unproductive. Top Temblor (Miocene 470 ft. Base Kreyenhagen 4,125 ft. Kern County.

Kettleman North Dome Field

K.N.D.A. 3-26-Q 26-22s-18e
Flowed 1,161 bbl., 37.4-gravity, 496,000 cu. ft. gas 128/64-in. bean. Pressures 100/600 lb. T.D. 7,830 ft. 7⅝-in. water string cemented 7,054 ft. 754 ft. 5 9/16-in. liner hung 7,021 ft. Perf. 7,530-7,775 ft. Cemented through perf. 7,520 ft., 7,530 ft. and 7,726 ft. Cemented blank sections 7,520-30 ft., 7,560-7,735 ft. 5,-997 ft. of 3-in. tubing. Top brown shale 5,545 ft., top Temblor 6,925 ft. Completed in Temblor oil sand. Kings County.

North Belridge Field

Belridge Oil Co. 8-1 Fee 1-28s-20e
Flowed 80 bbl., 44-gravity, 3 per cent cut, 6,676,000 cu. ft. gas. 96/64-in. bean. Pressures 500/250 lb. Elev. 627 ft. T.D. 8,227 ft. Completed in Wagonwheel zone of Eocene age. 9-in. casing cemented 7,850 ft. 340 ft. blank 6⅝-in. liner cemented 8,154 ft. and gun perf. with 376 holes 8,000-8,154 ft. 7,992 ft. 2⅞-in. tubing with packer. Top oil sand 7,886 ft. T point 7,656 ft., U point 7,696 ft., V point 7,839 ft. Kern County.

Northeast Coalinga Field

Standard 77-7-B Fee 7-19s-16e
Flowed 2,560 bbl., 27.1-gravity, 1,672,000 cu. ft. gas. Completed in Gatchell (Avenal) sand of Eocene age. T.D. 8,200 ft. 7-in. casing cemented 8,105 ft. 132 ft. 5-in. liner landed 8,195 ft. 60-mesh perf. at 8,105-95 ft. 8,151 ft. 2½-in. tubing. Top Kreyenhagen 7,030 ft., top green sand 7,993 ft., top oil sand 8,113 ft., bottomed in oil sand. Fresno County.

Texas Co. 2 Kimberlin 20-19s-16e
Flowed 510 bbl., 25.6 gravity, 225,000 cu. ft. gas. 16/64-in. bean. Pressures 1,280/1,300 lb. T.D. 8,219 ft. 11¾-in. cemented 597 ft., 5½-in. cemented 8,194 ft. 41 ft. of 4½-in. drillable liner landed 8,218 ft. Bottomed in oil sand. Completed in Gatchell (Avenal) sand of Eocene age. Fresno County.

Wilshire Annex 52-30-B 30-19s-16e
Flowed 844 bbl., 27.7 gravity, 400,000 cu. ft. gas. 19/64-in. bean. Pressures 1,000/1,150 lb. T.D. 8,250 ft. 7-in. water string cemented 8,180 ft. 104 ft. 5½-in. liner landed 8,250 ft. 100-mesh perf. open to production 8,210-50 ft. 8,109 ft. 2½-in. tubing. Top Kreyenhagen 6,800 ft., top green sand 8,025 ft., top oil sand 8,197 ft. Bottomed in oil sand. Completed in Gatchell (Avenal) oil sand of Eocene age. Fresno County.

Southeast Coalinga Field

Standard 7-17-F fee 17-20s-16e
Flowed 1,250 bbl., 27.6-gravity, 414,000 cu. ft. gas. T.D. 7,930 ft. 7-in. casing cemented 7,812 ft. 154 ft. 5-in. liner landed 7,925 ft. 60-mesh perf. 7,816-925 ft. 7,895 ft. 2½-in. tubing including 178 ft. 2-in. Top Kreyenhagen 6,550 ft., top green sand 7,681 ft., top oil sand 7,924 ft. Bottomed in oil sand. Completed in Gatchell (Avenal) sand of Eocene age. Fresno County.

Ten Section Field

Shell 83-30-A Kern County Land 30-30s-26e
Flowed 2,298 bbl., 33.7-gravity, 2,224,000 cu. ft. gas. Elev. 330 ft. T.D. 8,235 ft. Drilled by slim-hole method in 30 days from spud to completion. 8⅝-in. surface casing cemented 990 ft. 4½-in. casing landed 8,235 ft. and cemented through perf. 8,032 ft. Perf. 8,033-8,200 ft., 8,210-35 ft. 8,022 ft. in 2-in. tubing. Top of Stevens oil sand 8,035 ft. Bottomed in Stevens oil sand, Kern County.

Tupman Field

Richfield 81-31-B Kern County Land 31-30s-25e
Flowed 1,220 bbl., 33.7-gravity, clean, 1,000,000 cu. ft. gas. Two 1½-in. beans. Pressures 150/1,200 lb. Pressures with 3/64-in. bean 850/2,000 lb. T.D. 8,980 ft. 8⅝-in. water string cemented 8,462 ft. 539 ft. 6⅝-in. liner landed 8,975 ft. Perf. open to production 8,481-8,530 ft., 8,571-8,711 ft., 8,750-8,975 ft., 8,952 ft. 2½-in. tubing. Top first oil sand 7,900 ft. Bottomed in oil sand of second zone. Kern County.

Buena Vista Hills District

Honolulu 25-P Fee 10-32s-24e
Drilling 9,498 ft., in hard tight gray shale with streaks of sand, giving no cuts.

Pyramid Hills District

Associated 31 West Slope 20-24s-18e
Drilling 1,015 ft., and reaming. Expected oil sand absent.

Rio Bravo District

Wilshire 1 Campen 1-29s-25e
T.D. 1,592 ft. Cemented 13⅜-in. surface pipe 1,590 ft. Cleaning out to drill ahead. Kern County.

Rumsey Hills District

Standard 1 Tippetts 9-12n-3w
Drilling. Actual drilling being done by Taft Well Drilling Co. Yolo County.

Sacramento District

Ind. Expl. Co. 1 Perry 19-7n-6e
Derrick is being erected for wildcat approximately 12 miles southeast of Sacramento, the state capital of California.

Tejon District

Richfield 1 Tejon Ranch 2-10s-19e
Drilling 8,060 ft. Now in gray sand and shale. No showings to date. Kern County.

Union Avenue District

Hancock 1 Roberts 6-30s-28e
Location. Early work projected. Kern County.

East Coyote

Three wells were put on production in the East Coyote field of Orange County in Los Angeles basin during the current week and two of them were finished in the deep zone which was discovered several months ago by Bartholomae Oil Co. on the Stern lease. During the early part of the current week Bartholomae Oil Co. recompleted 3-A Stern after deepening the hole from 5,097 ft. to the new deep zone at 6,880 ft. and brought this well in pumping 475 bbl. of 26.2-gravity oil per day. The real significance of this deep zone has not yet been determined as only three wells have been completed in it to date. All have shown good initials but were brought in on the beam. The deep-zone discovery well was finished on the pump but started flowing after being on the beam for a week and is now back on the pump again. Standard 2-14 Coyote, a recent completion is at present pumping 660 bbl. of 26.1-gravity oil daily from 6,881 ft. and is making about 100,000 ft. of formation gas along with the oil. On the Toussau property which is owned in fee, Union Oil Company has just passed the 6,400 ft. level and should pick up this zone within the next week or 10 days. This well is northwest of the discovery well and the results of drilling will be watched with interest.

Inglewood

It is beginning to look like the lid might be blown off in the Inglewood field of Los Angeles Basin because in addition to 3-1 Los Angeles Investment of Standard Oil Co. in 17-22-14w, an offset to 1 Sentous of R. R. Bush Oil Co. the deep-zone discovery well, preparations are under way to start four additional wells. Standard Oil Co. is preparing to spud in 1-86 Los Angeles Investment within the next few days and has completed rig for 1-85 on the same lease. Kettleman & Inglewood Corp. has a derrick erected for 26 Rubel and has grade made for 27 Rubel. The former well will be drilled at once as contract has been let to the Brown Drilling Co. A deeper zone was proved productive a few months ago by 1 Sentous which proved to be a relatively small well. Lease requirements have forced the Standard Oil Co. to take steps to offset this well and as is usually the case when one operator gets into a new zone others must follow suit in compliance with lease requirements. No steps have yet been taken by Tide Water Associated Oil Co., Shell Oil Co. or Texas Co. to begin exploitation of the recently discovered deep zone but they will be forced to do so in the near future as their lease requirements are just as positive as other leases in the field. The field at present has a total of 293 wells of which 101

are standing shut in because of curtailment. Deep zone exploitation if prosecuted to the fullest will result in the drilling of about 100 additional wells.

LOS ANGELES BASIN COMPLETIONS

East Coyote Field

Bartholomae Oil Corp. 3-A Stern 22-3s-10w
Pumped 475 bbl., 26.4-gravity, 4 per cent cut. Deepened from 5,097 to 6,880 ft. 8⅝-in. cemented 3,345 ft. 5½-in. landed 6,880 ft. and cemented through perf. 5,575 ft. Perf. 5,595-6,880 ft. 2½-in. tubing including 2,000 ft. of 2-in. hung 5,500 ft. Completed in deep zone discovered several months ago. Orange County.

Metro Pet. 10 Robinson 18-3s-9w
Pumped 198 bbl., 22.1-gravity, 10 per cent cut. T.D. 4,260 ft. 6⅝-in. water string cemented 4,238 ft. 45 ft. 5-in. liner landed 4,260 ft. Perf. 4,230-60 ft. 3,900 ft. 2½-in. tubing. Orange County.

Standard 2-14 Coyote 22-3s-10w
Pumped 6,945 bbl., 26-gravity, 2 per cent cut, 150,000 cu. ft. gas. T.D. 6,881 ft. 8⅝-in. casing cemented 3,883 ft., 6⅝-in. liner landed 6,874 ft. and cemented through perf. 5,673 ft. Perf. open to production 5,676-6,874 ft. 6,007 ft. 2½-in. tubing. This well located west of deep-zone discovery well and completed in deep zone. Orange County.

Huntington Beach Field

Signal O. & G. 13-A Bolsa 34-5s-11w
Flowed 468 bbl., 23.6-gravity, 300,000 cu. ft. gas 28/64-in. bean. Pressures 410/620 lb. T.D. 4,625 ft. 8⅝-in. casing cemented 3,485 ft. and through perf. 995 ft. 1,159 ft. 6⅝-in. liner landed 4,624 ft. Perf. open to production 3,483-4,144 ft. and 4,300-4,624 ft. 4,085 ft. 2½-in. tubing. Located west end of field on acreage leased earlier this year. Drilled from spud to completion in 23 days total elapsed time. Orange County.

Long Beach Field

R. A. Brown, M. & T. Old Biddy 19-4s-12w
Pumped 130 bbl., 22.6-gravity, 3 per cent cut. T.D. 3,423 ft. 5¾-in. casing cemented 3,270 ft. 160 ft. 4-in. liner landed 3,423 ft. Perf. open to production 3,278-3,423 ft., 3,375 ft. 2½-in. tubing. Los Angeles County.

Texas 16 Harlow Kent 19-4s-12w
Pumped 574 bbl. gross including 175 bbl. circulating oil. 10 to 20 per cent cut. T.D. 3,474 ft., drilled out to 3,446 ft. 7-in. casing cemented 3,471 ft. and through perf. 706 ft. Gun perf. 3,302-22 ft., 3,350-75 ft., 3,273 ft. 2½-in. tubing. Los Angeles County.

Richfield (Yorba Linda) Field

F. E. Fairfield 1 Tuffree 21-3s-9w
Pumped 85 bbl., 16.6-gravity, 2 per cent cut. T.D. 2,137 ft. 8⅝-in. casing cemented 1,965 ft. 200 ft. 6⅝-in. liner cemented 2,137 ft. Knife-perf. 2,040-70 ft. 1,750 ft. 2½-in. tubing. Orange County.

Rosecrans Field

St. Anthony 5 Gordon 19-3s-13w
Flowed 1,100 bbl. daily rate but declined to 250 bbl., 32.1 gravity. T.D. 7,952 ft. 7⅝-in. water string cemented 7,576 ft. 400 ft. 5½-in. liner landed 7,952 ft. Perf. open to production 7,571-952 ft. 7,925 ft. 2½-in. tubing. Completed in O'Dea zone. Los Angeles County.

Wilmington Field

Long Beach Oil Dev. 18-W Harbor 10-5s-13w
Ranger zone flow 659 bbl., 22.4-gravity, 132,000 cu. ft. gas. T.D. 4,064 ft. 25/64-in. bean. Pressures 300 lb. Lower Terminal zone flow 360 bbl., 29.2-gravity. 2.2 per cent cut, 503,000 cu. ft. gas. 17/64-in. bean. Pressures 375 lb. 11¾-in. casing cemented 2,637 ft. 8⅝-in. landed 4,056 ft. 10-in. outside diameter gravel packed liner. Perf. 2,637-2,880 ft., 3,539-3,834 ft., 3,880-4,050 ft. Cemented through perf. 3,244 ft. and 3,539 ft. 4,008 ft. 2½-in. tubing with packer 2,837 ft. Los Angeles County.
Pumped 185 bbl., 16.8-gravity. T.D. 3,140 ft. 8⅝-in. casing cemented 2,799 ft. Pulled 6⅝-in. liner from 2,876 ft. Set whipstock 2,875 ft. and redrilled to 3,140 ft. Then landed 5¾-in. liner 3,140 ft. Used gravel packed liner 2,830-3,135 ft. Heaving plug 3,132 ft. Completed in Ranger zone. Los Angeles Count..

U. P. R. R. 153 Fee 4-5s-13w
Flowed 140 bbl., 29.9-gravity. No flow test made. Well completed in Ford zone. Upper zones cased off with blank liner or casing. T.D. 5,523 ft. 10¾-in. casing cemented 2,455 ft. 2,813 ft. of blank 7-in. liner cemented 5,062 ft. and again through perf. at 3,592 ft. 472 ft. of 4¾-in. liner landed 5,509 ft. Perf. open to production 5,064-5,159 ft., 5,297-5,361 ft., 5,458-5,500 ft. 4¾-in. liner was cemented through perf. at 5,295 ft. and 5,456 ft. 5,111 ft. 2½-in. tubing. Los Angeles County.

LOS ANGELES BASIN OUTPOSTS

Dominguez Field

Union 79 Callender 32-3s-13w
Drilling 8,698 ft. 16-in. surface pipe cemented 954 ft. 9⅝-in. casing cemented 7,005 ft. as protection string. This well, located in west central part of field is scheduled to be carried down as deep test. Los Angeles County.

Long Beach Field

Union 19 L.B.C. 30-4s-12w
Drilling sand and shale 4,999 ft. Lost circulation, pumped in cement. Los Angeles County.

LOS ANGELES BASIN WILDCATS

Dominguez-Gardena District

Wood-Mellon 1 Wood 31-3s-13w
T.D. 7,795 ft. P.B. 2,400 ft. Will have look at Seventh Callender zone, redrilling 6,952 ft. Los Angeles County.

Inglewood District

Standard 3-1 L.A.I. 17-2s-14w
Drilling 3,767 ft., hard shale. Los Angeles County.

Malibu District

Sovereign Oil Co., 1 Malibu 7-2s-18w
T.D. 3,292 ft. in very hard conglomerate with tight gray sand and streaks of shale. Lost cones. Logged basalt 3,214-22 ft. Possible fault zone. Los Angeles County.

Pico District

Cal-Pico, 1 Pico 7-2s-11w
T.D. 7,198 ft. Cleaning out to resume drilling operations after temporary suspension. Los Angeles County.

Whittier District

Fullerton, 6 Whittier 25-2s-11w
Drilling 3,398 ft., sandy shale. This wildcat is situated between 1 Sansinena and 1 Mineral Springs of Union Oil Co. both of which showed production possibilities. 220 ft. 11¾-in. casing set as surface pipe. Joint test with Union Oil Co. Los Angeles County.

COASTAL DISTRICT

The reason for the substantial purchases of producing properties in the Santa Maria Valley field during the past several weeks became evident this week with release of Union's statement of earnings for the 9 months' period. This statement under the caption of capital expenditures states, "During the third quarter, construction work was started on a distillation plant to reduce heavy crude oil to petroleum coke, which coke the Pacific Gas & Electric Co. has contracted to purchase. This plant will effectively refine high-sulfur-bearing crude oils. During this same period, work was started on a catalytic cracking plant which will permit more economical manufacture of high-quality gasolines. These facilities are expected to be completed during 1941." For several weeks the industry has been wondering why Union Oil Co. has been making major purchases in the Santa Maria Valley because for several years this field has been regarded in an unfavorable light. Santa Maria Valley crude oil contains about 21 per cent gasoline under straight distillation and the remainder is a thick viscous tarry residue. By cracking to the coke stage, recoveries should be materially improved and the undertaking advantageous due to favorable disposal of the residue coke to the Pacific Gas & Electric Co. Under the terms of this contract, Pacific Gas & Electric Co. will take Union's coke and heavy oil and some flue gas and furnish light and power for Union's operations at Oleum refinery. A few weeks ago, Union purchased the production and lease holdings of Ohio Oil Co. in the Santa Maria Valley field and a short time later acquired the production and leases of E. H. Moore, Inc., of Tulsa, Oklahoma, for a consideration of $600,000 less the expense of reacquiring some properties and a 15 per cent interest in the Union Sugar Co. leases.

COASTAL DISTRICT COMPLETIONS

Padre Canyon Field

General Pet. 3 Padre 15-3n-24w
Flowed 340 bbl., 30.5-gravity, 199,000 cu. ft. gas. Elev. 512 ft. T.D. 5,181 ft. 6⅝-in. water string cemented 4,900 ft. 306 ft. 4¾-in. liner landed 5,181 ft. Perf. open to production 4,897-5,000 ft., 5,091-5,181 ft., 4,842 ft. of 2½-in. tubing with packer at 4,810 ft. Bottomed in oil sand. Ventura County.

Shiells Canyon Field

Field Gas Corp. 3-B Calumet 3-3n-19w
Pumped 100 bbl., 32.1-gravity, clean. Elev. 924 ft. T.D. 2,692 ft. 9-in. casing cemented 2,554 ft. 2,500 ft. 2½-in. tubing. Bottomed in oil sand. Ventura County.

Ventura Avenue Field

Shell 126 Taylor 29-3n-23w
Flow 171 bbl., 30.1-gravity, 50 per cent cut, 1,193,000 cu. ft. net, formation gas. Completed on compressor. Elev. 379 ft. T.D. 6,950 ft. 7⅝-in. water string cemented 5,877 ft. 1,110 ft. 5½-in. liner landed 6,945 ft. Perf. open to production 5,888-5,970 ft., 6,016-6,125 ft., 6,170-6,213 ft., 6.258-6.541 ft., 6.631-6,945 ft., 6,974 ft. ½-in. tubing. Ventura County.

Tide Water Associated 70 Lloyd 26-3n-23w
Flowed 135 bbl., 31-gravity, 2.5 per cent cut, 139,000 cu. ft. net formation gas. Completed on compressor. Elev. 810 ft. T.D. 7,785 ft. 7⅝-in. water string cemented 7,625 ft. 202 ft. of 4-in. liner landed 7,780 ft. Perf. open to production 7,534-7,780 ft. Ventura County.

COASTAL DISTRICT WILDCATS

Capitan District

Milburn & Hamilton 1 Rutherford 36-5n-31w
Drilling in sand and shale. Started as core hole but if conditions warrant it will be converted irto a wildcat hole and drilling continued.

Cat Canyon District

Union, 11 Bell 27-9n-33w
Drilling 4,584 ft. in sandy shale. Santa Barbara County.

Coal Oil Point District

Bolsa Chica 191-7 Permit 25-4n-29w
Drilling 3,699 ft. in sand and shale. Santa Barbara County.

Huasna District

Harvey Oil Corp. 1 Huasna 11-32s-14e
Drilling 3,387 ft. in sand and shale. San Luis Obispo County.

Shiells Canyon District

O. C. Field 2 Calumet 3-3n-19w
T.D. 3,674 ft. Will deepen if liner can be recovered. 10¾-in. casing cemented 3,638 ft. Larger production expected around 4,000 ft. in Sespe if successful. Ventura County.

Tar Springs District

Superior 1 Tar Springs 24-32s-14e
Drilling 6,310 ft. in hard shale. San Luis Obispo County.

SAN JOAQUIN VALLEY OUTPOSTS

Kettleman North Dome Field

Standard 344-13-H fee 13-21s-16e
Drilling hard sand and shale 10,571 ft. Fresno County.

Standard 1-1-U Fee 1-23s-16e
Drilling hard shale 8,780 ft. Kings County.

Paloma Field

Western Gulf 12-12-B Kern County Land 12-32s-26e
Drilling sandy shale 2,984 ft. 13⅜-in. surface pipe cemented 1,229 ft. Kern County.

Rio Bravo Field

Union 72-28 Crites 28-28s-25e
Drilling sandy shale 10,284 ft. Kern County.

Union 76-27 Kern County Land 27-28s-25e
Drilling 11,576 ft. in barren gray sand. P.B. 8,150 ft. Kern County.

Union 41-33 Pacific States 33-28s-25e
Location staked in extreme western end of field. Early work projected. Kern County.

Round Mountain

Spartan Drlg. Co. 1 Hiatt 32-28s-29e
Fishing, 2,089 ft.

Strand Field

Associated 25-7-E Kern County Land 7-30s-26e
Drilling 9,868 ft. in hard sand and shale. Kern County.

Wasco Field

Pacific Western 1 Meyer 7-27s-24e
T.D. 13,150 ft. Kern County.

Wheeler Ridge

Richfield 2 Kern County Land 28-11n-20w
Drilling 9,750 ft. in sand and shale. Kern County.

SAN JOAQUIN VALLEY WILDCATS

Cantua District

Texas 1 Everding 24-17s-15e
Drilling 10,150 ft. in hard tight gray sand and shale of Domengine. D.P. froze 10,150 ft. Fresno County.

Kreyenhagen District

Continental 1 Kreyenhagen 4-22s-16e
Drilling 10,970 ft., in hard siltstone of Eocene age. Fresno County.

North Louisiana-Arkansas

(Continued from Page 228)

McCreslen Oil Co. 4 Hadley ..... SE SE SW 3-18-13

ARKANSAS WILDCATS

Clark County

Coker Oil Corp. 1 Guess ..... NE SE NE 2-11-20
Bailed est. 10 bbl. fluid, est. 1 bbl. 10-gravity oil. S.D., may install pump, T.D. 612 ft.

W. P. Wilson 1 Hamilton-Mathews .. NW SW 32-10-20
S.D., engine repairs 1,572 ft.

Hempstead County

S. H. Cadenhead et al 1 J. J. Bruce .. SE SE 27-10-24
S.D. 206 ft.

Lonoke County

Lunnon Howell & Ford 1 City of Cabot ..... Lot 1, Blk. 6, 18-4n-9w
Drilling 1,337 ft.

J. F. Russell 1 J. T. Gunter ..... SE SE 17-5n-10w
S.D. 2,785 ft.

Nevada County

Coker Oil Corp. 1 B. Jones ..... NE SE 2-11-21
Drilling shale 1,062 ft.

Prairie County

Hazen Oil Co. 1 Fidelity Mutual Life Ins. Co. ..... NE NE SW 16-2n-6w
S.D. 320 ft.

Saline County

A. W. Givens 1 Williams ..... NW NE NE 18-3s-15w
T.D. 690 ft., fishing.

Tedford Drlg. Co. 1 Williams 31-3s-15w
Drilling shale 495 ft.

St. Francis County

United States Oil Corp. (former Hargraves et al J. T. Wilford ..... NE SE NE 29-4n-1w
10¾-in. casing 242 ft., T.D. 282 ft.

ARKANSAS COMPLETIONS

Urbana—Union County

McCreslen Oil Co. 1-B Howe ..... SE SW SW 3-18-13
65 bbl., 8 per cent salt water, 10/64-in. choke, T.P. 150 lb., C.P. 500 lb., 7-in. casing 3,054 ft., perf. 2,952-56 ft., T.D. 3,534 ft.

EAST TEXAS BORDER FIRST REPORTS

Waskom—Harrison County

Arkansas Louisiana Gas Co. 1 T. R. Scott, S. Dickerson Sur.

Union Prod. Co. 1-A Bryson, T. D. Wilson Sur.

EAST TEXAS BORDER COMPLETIONS

Bethany—Panola County

Holcombe & Thomason 15 Crenshaw, Thomas W. Cox Sur., 25,000,000 cu. ft. gas, est. open flow, T.D. 6,111 ft., 7-in. casing 6,108 ft., perf. 6,010-24 ft., two D.S. tests failed, reperf. 6,010-24 ft. and 5,836-50 ft., completed, T.P. 2,250 lb., C.P. 2,450 ft., Travis Peak.

EAST TEXAS BORDER WILDCATS

Bowie County

J. G. Strahan 1 Lewis Fort, L. Peters Sur., old T.D. 2,337 ft., P.B. 1,900 ft.

Lee Timberlake et al 1 Smith, T. H. Hill Sur., drilling 2,430 ft.

Shelby County

Paul Pewitt 1 J. S. Swann, Ann Grey Sur., T.D. 5,105 ft., tested gas and salt water 5,000-10 ft., preparing to P.B.

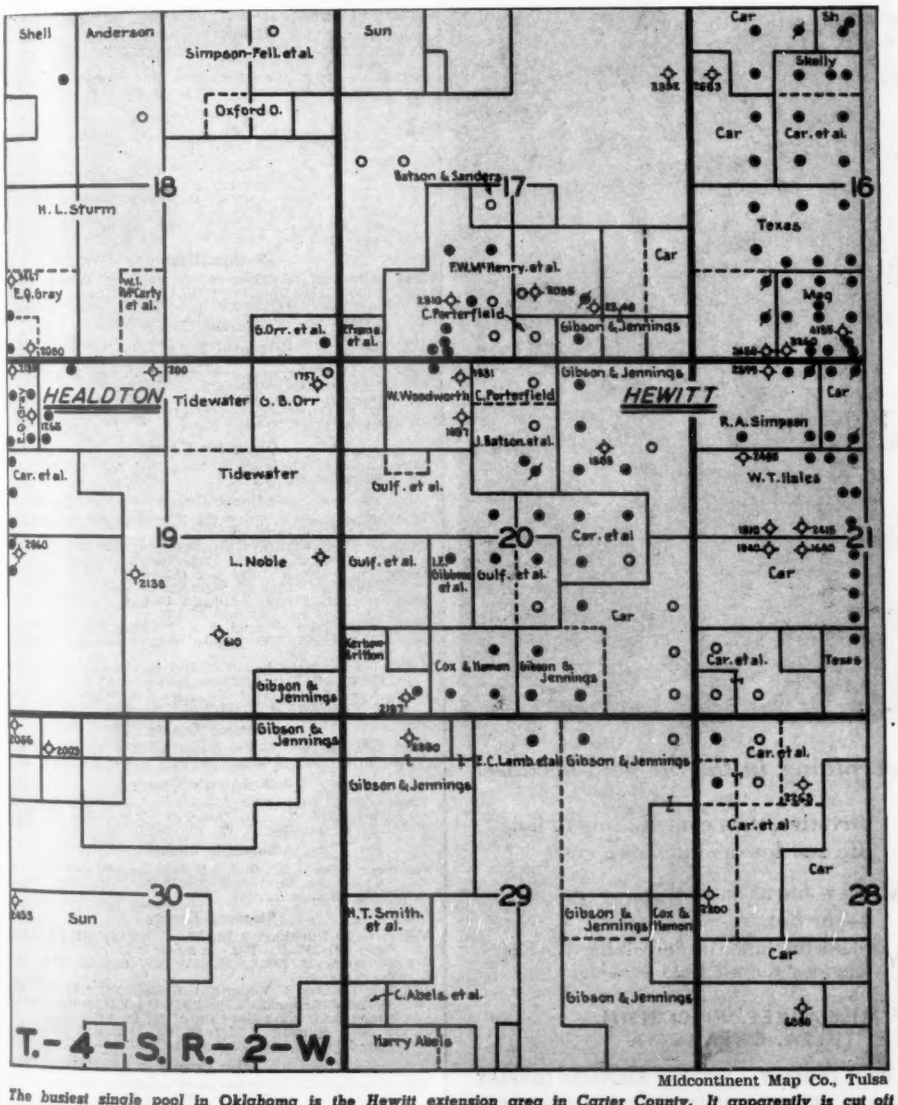
By
DAL DALRYMPLE

Find New Seminole Oil Area; Caddo Wildcat Taps Water

THE discovery of a promising oil area in Seminole County, completion of a small oil-pool opener in Lincoln County and a gas discovery in McIntosh County, and disappointment at a highly regarded wildcat test in Caddo County were features of a busy week in Oklahoma fields. Another larger producer was near completion in the north end of the Dill pool, development in the West Hewitt area continued at a rapid pace and the tempo of wildcat exploration throughout the state continued to increase.

Amerada Petroleum Corp. 1 Campbell, N½ SW SW 30-9-6, prospective pool opener in Seminole County, topped Simpson dense at 4,170 ft., dolomite 4,195 ft., Wilcox sand 4,220 ft. and at 4,237 ft. oil rose 1,000 ft. in the hole. It was swabbed down, making 16 bbl. of oil in 1 hour. It later was swabbed once an hour, yielding 7 or 8 bbl. each time. Operators were to deepen slightly before testing. Location is on a small seismograph structure, which, while not expected to be large, may be prolific. It is south of the East Earlsboro and north of the Mission pool.

The Texas Co. 1 Smith, C NE NW 2-5-12w, wildcat near Apache in Caddo County, provided the big disappointment of the week when salt water intruded. The wildcat was started in September, 1938, on a seismograph structure about 14 miles long from northwest to southeast. It was regarded as one of the more promising structures in Oklahoma. High prices were paid by the Texas Co. for leases on the structure, many of them being bought at the Kiowa Indian Agency in Anadarko for the company by Quintin Little, the Madill man who assembled the big Pure Oil Co. block in the Cumberland area. The 1 Smith topped Hinton lime extremely high at 1,661 ft., Sylvan shale at 2,258 ft. and at 2,424 ft. a cavity was struck. A blowout of high-pressure air resulted, with another such blowout at 2,455 ft. Viola lime was found at 2,543 ft., casing was set at 2,544 ft. on October 11, 1938, and work was suspended while the company went about the business of developing its properties in Illinois. Work was resumed late in July of this year and, after cleaning out and conditioning hole, it is drilled to 3,423 ft., where a survey showed a crooked hole. It was plugged back to base of the pipe and redrilled, topping Simpson dense at 3,715 ft. After drilling to 4,372 ft., packer was set at 2,510 ft. and drill-stem tester was left open for 2½ hours. Some gas broke through, followed by water, estimated at 50 bbl. an hour before the tester was closed. Operators plugged back and planned to test several upper zones.



Midcontinent Map Co., Tulsa

The busiest single pool in Oklahoma is the Hewitt extension area in Carter County. It apparently is cut off from the main Hewitt pool by several dry holes. Dry holes also separate it from the Healdton field, to the west. Producers range from 50 to 55 bbl. daily, initially

Estimated Daily Production

Estimated daily production in Oklahoma for the week ended November 9, and for the preceding week, was as follows:

	Barrels	
	Nov. 9	Nov. 2
Allen	5,050	5,025
Billings	6,150	6,125
Burbank	7,025	7,025
South Burbank	7,150	7,100
Balance Osage	16,750	16,500
Blackwell district	3,375	3,350
Bristow-Slick	5,875	5,800
Chandler	1,100	1,050
Crescent	1,775	1,725
Cromwell	2,975	2,950
Cushing-Shamrock	8,975	8,900
Duncan	3,550	3,575
Edmond	3,975	3,925
Fish	3,000	3,000
Fitts	15,000	14,100
Jesse	2,075	2,050
Graham-Fox	2,275	2,350
Gray	875	850
Healdton	8,575	8,550
Hewitt	5,325	5,200
Keokuk	2,800	2,800
Konawa	1,025	1,025
Lucien	6,975	6,925
Moore	1,275	1,300
Northeastern counties	17,500	17,150
Oklahoma City	89,550	94,300
Olympic	1,900	1,875
Ramsey	3,650	3,550
Sasakwa	1,475	1,450
Sholem-Alechem	2,600	2,600
Seminole district:		
Bowlegs	6,650	6,625
Carr City	2,175	2,175
Dora	1,850	1,850
Earlsboro	4,100	4,075
East Earlsboro	1,725	1,700
South Earlsboro	500	500
Little River	6,475	6,425
East Little River	650	625
Maud	525	500
Mission	1,200	1,200
Seminole	6,675	6,625
East Seminole	1,075	1,050
Searight	1,950	1,925
Total Seminole	35,550	35,275
St. Louis-Pearson	22,925	22,700
Tatums-Tussy	3,850	4,000
Tonkawa-Garber-Thomas	3,550	3,550
Wewoka	1,550	1,550
Yale-Jennings	2,950	2,950
Other pools	82,850	85,050
Total Oklahoma	392,825	394,500

Tenth for Cumberland

The tenth producer in the Cumberland field, on the Marshall-Bryan county line, was near completion at Pure Oil Co. 3 Little-100, NE NE SE 28-5s-7e. It was bottomed at 5,070 ft., 7-in. pipe was set at 4,869 ft. and it flowed 939 bbl. of oil in 15¾ hours, flowing 131 bbl. the first hour through casing and the remainder of the time flowing through chokes. Operators continued to test at 1 Park College, SW SW SE 27-5s-7e, farthest southeast test in Bryan County. At plugged-back depth of 5,118 ft., it swabbed 24 bbl. of oil in 6 hours.

The Dill pool in Okfuskee County was extended a location northeastward at Shell Oil Co. 2 Curry, SE SW NW 35-12-8. It found Cromwell sand at 3,558-3,607 ft., total depth, flowed 425 bbl. of oil in 19 hours through 2-in. tubing and was shut in for pipe-line connections. Location was staked for Shell 3 Curry, NW SW NW 35-12-8.

Earlier in the week, John Doppleman et al 3-C Dill, NE NE SE 34-12-8, flowed 75 bbl. of oil an hour, initially. Seven-inch casing was set on top of Cromwell sand at 3,335 ft., total depth 3,542 ft. Same operator's No. 4-C Dill, SE SE NE 34-12-8, was drilling ahead, and work was due to start at No. 5-C Dill, NW NE SE 34-12-8. One-fourth mile north and slightly east of the Shell-Curry operations, H. E. Lee and others set surface pipe with machine and was completing derrick at 1 Ramsey, SE NE NW 35-12-8.

The north trend of Wilcox production in the Coyle

pool, Payne County, was defined at Mid-Continent Petroleum Corp. 3 Johnson, W½ SE SE 2-17-1e. It found water in Wilcox sand at 4,945 ft., with pipe set at 4,867 ft. It was plugged back and perforated in Hunton lime at 4,623-26 ft., and flowed 115 bbl. of oil and an estimated 1,500 bbl. of water in 24 hours. Testing continued. Wells on the east side of the field flowed clean oil on drill-stem tests in Hunton lime while drilling, but a plugged-back well at the southeast end of the pool yielded only a small amount of oil and much water from Hunton.

Indian Territory Illuminating Oil Co. started work at 1 Cronkite, NE SE NW 22-15-4w, wildcat southwest of Navina, Logan County. It is to be drilled to 7,000 ft. or 50 ft. in the Wilcox zone. Location is on a trend from the Edmond field in Oklahoma County to the Crescent field in Logan County. Several deep, dry holes have been drilled in the Navina area.

Gulf Oil Corp. et al 1 Qualls, C SW NE 23-1n-7w, northeast of Duncan, Stephens County, deepest drilling well in the state, was making hole below 10,100 ft.

OKLAHOMA COMPLETIONS

Beckham County

Erick area: Westoak Gas 1 Roles, C NW SE 11-9-25w. Dolomite 2,920 ft., lime 3,492-2,503 ft., gaged 2,500,000 cu. ft. gas.

Caddo County

Cement field: George Pace 1 Prentice, NE NE SW 6-5-9w. Set 6-in. 3,400 ft., T.D. 3,471 ft., perf. 3,330-34 ft., pumped 105 bbl.

Carter County

Healdton field: Magnolia 81 Richards, S½ S½ S½ 31-3s-3w. Set 7-in. 1,039 ft., T.D. 1,140 ft., P.B. 1,137 ft., pumped 83 bbl. oil and 46 bbl. water.

Hewitt field: Neustadt 1 Bennett, SW SW NW 17-4s-2w. Sand 2,413-16 ft., T.D., P.B. 2,172 ft., shot 2,162-72 ft., slight showing of oil, S.D.

Neustadt 2 Bennett, SE SW NW 17-4s-2w. T.D. 1,600 ft., dry.

Batson et al 3 Walker, SW NW NE 20-4s-2w. Lime 1,994-95 ft., sand 1,995 ft., 7-in. 1,994 ft., T.D. 2,046 ft. in sand, shot with 50 qt. 2,012-46 ft., flowed 226 bbl. through tubing.

Gibson & Jennings 4 Griffin, NE SE SE 20-4s-2w. Sand 2,135-78 ft., T.D., shot with 70 qt. 2,158-78 ft., swabbed 508 bbl. the first 24 hr., pumped 365 bbl. daily.

W. T. Turner 1 Rose, SW SW SW 21-4s-2w. Sandy lime and shale 2,098-2,167 ft., 7-in. 2,074 ft., T.D. 2,197 ft., pumped and flowed 432 bbl.

W. T. Turner 2 Stearns, NW SW SW 21-4s-2w. Set 7-in. 2,190 ft., T.D. 2,232 ft., pumped and flowed 480 bbl.

Jones 5 Sullivan, NE NW SE 36-4s-2w. Set 7-in. 2,501 ft., T.D. 2,600 ft., perf. 2,196-2,222 ft., pumped 21 bbl.

Gibson & Jennings 2 Lamb, NE NE NE 29-4s-2w. T.D. 2,230 ft., pumped 63 bbl.

Comanche County

Lawton area: Griffin & Kelly 1 Bohner, NE NE NE NE 35-2n-11w. T.D. 230 ft., dry.

Griffin & Kelly 2 Bohner, NE NW NE NE 35-2n-11w. T.D. 240 ft., dry.

Creek County

Cushing field: Glenn 1 Merriett, NE SW NW 26-18-7. Sand 1,918-60 ft., T.D. 1,970 ft., shot with 40 qt. at 1,933-60 ft., pumped 25 bbl.

Glenn pool: D. W. Franchot 36 Kiefer, SW SW NW SW 17-17-12. T.D. 1,415 ft., repressure well.

Sinclair Prairie 35 Kiefer, NE SW SE 17-17-12. T.D. 1,538 ft., pumped 32 bbl.

Miscellaneous: Bryan Pet. 2 Ah-say, NW NW NE 34-14-7. Broken Prue sand 2,582-2,600 ft., T.D. 2,945 ft., dry.

Williams 1-A Ralston, SW SW NW 6-16-10. Bartlesville 2,355-75 ft., S.D., slight showing of oil and water.

Tilley 5 Wright, NW NE SE 17-17-8. Set 7-in. 2,319 ft., Prue 2,320-54 ft., T.D., flowed 50 bbl.

Grady County

Knox field: W. S. Critchlow 8 Adair, NW NW SW NW 27-3n-5w. T.D. 2,713 ft., pumped 5 bbl.

Jefferson County

Oscar area: Beck 10 Seay, SW SW SE 34-6s-5w. Lime 1,619-22 ft., T.D., P.B. 1,534 ft., pumped 7½ bbl.

Kiowa County

Wildcat: Dempsey & Son 1 Dempsey, SW NW NE 31-4-18w. Lost hole at 290 ft., dry.

Wildcat: Hurst & Groth 1 Groth, SE SW SW SW 3-4n-16w. T.D. 520 ft., lost hole, dry. At both wildcats rigs were skidded to new locations.

Lincoln County

Wildcat: Mason & Stuart 1 Crane, SW NE SE 7-12-5, about 3 mi. west of South Wilzetta pool. Lower Skinner 4,220 ft., T.D. 4,242 ft., shot with 30 qt. 4,229-42 ft., pumped 98 bbl. first 18 hr., pumped 81 bbl. daily; gravity of oil 36°.

Sac and Fox pool: Wilcox O. & G. 2 Crane, NE NW NW 21-14-6. Oswego 3,066 ft., 5-in. 3,067 ft., Prue 3,070 ft., T.D. 3,135 ft., shot, flowed 55 bbl.

McIntosh County

Wildcat: McNutt & Young 1 Life, SE SE SW 1-12-16, northern part of county on gas trend into Muskogee County. Booch sand 1,473-85 ft., T.D., gaged 2,000,000 cu. ft. gas, with 410 lb. R.P.

Muskogee County

Council Hill area: E. M. Jordan 1-B Davis, NW NW SE 17-13-16. T.D. 2,235 ft., dry.

Noble County

North Lucien pool: Sunray 2 Guthrie, SW NE SW 31-21-2w. Wilcox 5,409-62 ft., T.D., shot 5,412-46 ft., pumped 13 bbl.

Wildcat: Frank & Ellis 1 Strasky, SW SW NW 35-24-1w. T.D. 2,260 ft., S.D.

Nowata County

Miscellaneous: McBride et al well on White farm, 11-27-14. Bartlesville 1,153-1,205 ft., shot by Mid-Continent Torpedo at 1,179-1,203 ft., small oil well.

Okfuskee County

Dill pool: John Droppleman 3-C Dill, NE NE SE 34-12-8. Cromwell 3,543 ft., T.D. 3,582 ft., flowed 632 bbl. in 10 hr. through casing, flowed 200 bbl. in 24 hr., through tubing.

East Okemah area: Phillips et al 2 Johnson, SW NW NE 11-11-10. Cromwell 3,177 ft., 7-in. 3,198 ft., T.D. 3,213 ft., flowed 285 bbl.

Okmulgee County

Miscellaneous: Eagle Oil 1 Nash, SE NW SE 18-14-11. T.D. 3,107 ft., dry.

Osage County

Branstetter area: Trinity Oil 2 Osage, SE SE NE 28-22-11. T.D. 745 ft., dry.

Quapaw pool: I.T.I.O. 475 Osage, N½ SW NE 28-25-11. T.D. 1,906 ft., gaged 1,325,000 cu. ft. gas.

Domes pool: Cecil Juby 1-A Osage, SE NW NW 13-27-10. T.D. 1,295 ft., pumped 15 bbl.

Manion area: Finance Oil 29 Osage, C SW 19-23-9. T.D. 2,498 ft., pumped 22 bbl.

Osage City pool: Franchot & Finance Oil 21 Osage, NE NW NE NE 2-21-9e. T.D. 1,430 ft., pumped 12 bbl.

Tidal-Osage pool: Power & Quinlan 12 Osage, SE SW SE 26-24-8. T.D. 2,486 ft., pumped 40 bbl.

West Avant area: Opal Twyman 1-A Osage, E½ SW SE NW 28-23-11. T.D. 1,895 ft., dry.

Pontotoc County

East Ada district: Moore 1 Julius, NW SE NW 6-4-7. Sand 920-947 ft. and 1,162-67 ft., T.D. 1,202 ft., dry.

Pottawatomie County

Prague pool: Simpson-Fell 1 Hale, NW NW NE 4-11-6. Sand 3,280 ft., 7-in. 3,278 ft., T.D. 3,334 ft., P.B. 3,319 ft., pumped 5 bbl. oil and 5 bbl. water.

Seminole County

Seminole field: Stanolind 1-B Grisso, NW NE SW 15-9-6. Senora sand 2,887-2,924 ft., T.D., shot 2,910-20 ft., flowed 72 bbl.

Stephens County

Velma field: Burkhart 9 Burkhart, NE NE SE 27-1s-5w. Sand 691-735 ft., T.D., pumped 3 bbl.

Carl Carter 11 Doak, SW SW NW 6-2s-4w. T.D. 765 ft., S.D.

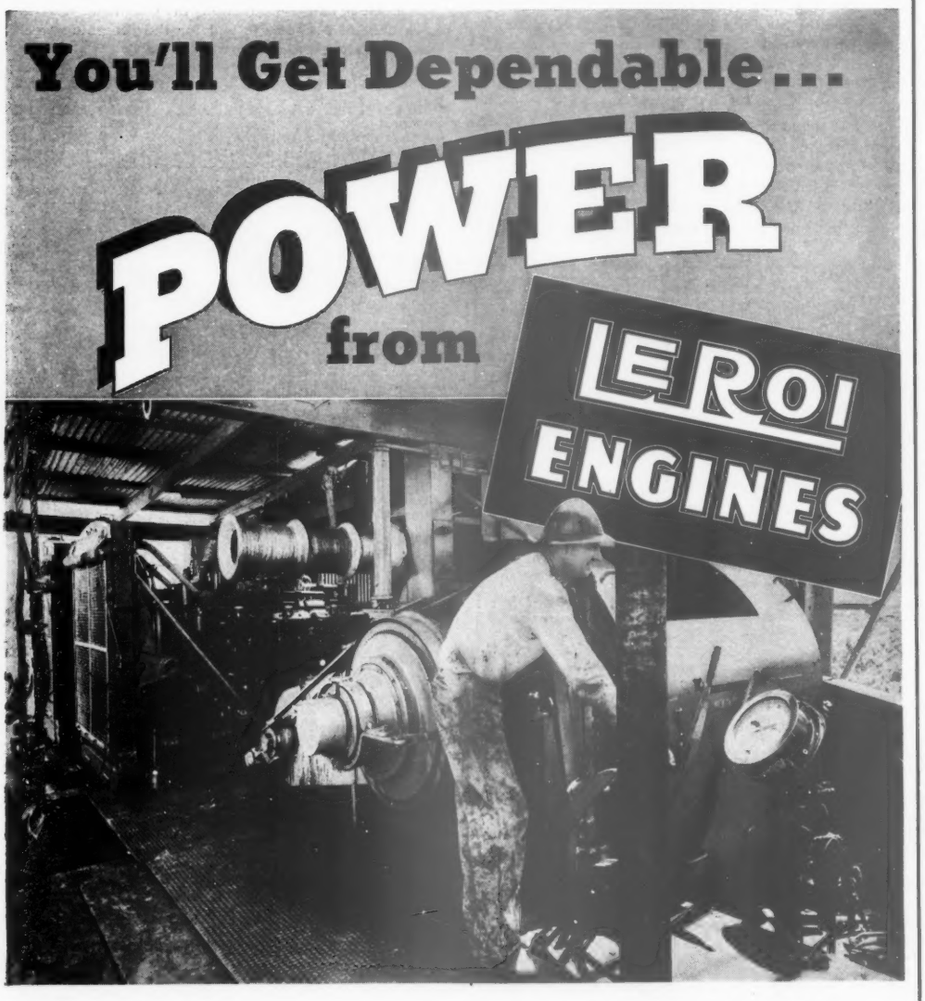
Wildcat: Grimes & Vaughn 1 Baker, NE NE SW NE 35-2s-6w. Arbuckle 1,793-1,811 ft., T.D., junked hole, abandoned; good showing of oil in Arbuckle.

Doyle pool: Sunray 2 Hefner, SE NW SW 12-1n-5w. T.D. 6,242 ft., flowed 120 bbl.

Tulsa County

Miscellaneous: J. A. Egan well on Bell farm, 5-19-11. Bartlesville 1,648-69 ft., T.D. 1,700 ft., shot with 70 qt. by Mid-Continent Torpedo at 1,648-66 ft., small oil well.

(Continued on Page 252)



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Deep Limestone County Test to Go to Travis Peak Formation

By R. MARNE SANFORD

DALLAS, Tex., Nov. 11.—The interest of the eastern Texas district shifted the past week from the prospective Woodbine sand discovery at Hawkins in Wood County to the Balcones fault system of southern Limestone County. Some of the earliest production in East Texas was from the Woodbine sand along the Mexia fault zone of the Balcones fault system in Limestone and Navarro counties. It has been only the past few years that deep possibilities have been considered along the same fault trend. Several deep failures were drilled about 2 years ago in southern Limestone County. During the past week a long shutdown wildcat was scheduled for testing from the Travis Peak and a new Travis Peak wildcat was staked.

Perhaps most stimulating to the area was the purchase by Gulf Oil Corp. of half interest in this long shutdown wildcat. It was formerly Frank Bryan, Waco, and John E. Farrell Drilling Co., Fort Worth, 1 Bevill. Gulf purchased the Bryan half interest for the consideration of $150,000 cash, which included half interest in the 400-acre drill site and full interest in 9,000 acres in outlying tracts. The well, shut down for some time since reporting saturation in the Travis Peak, is scheduled to be tested the coming week. Its total depth is 4,937 ft. in the Travis Peak, with the top of the section being called at 4,924 ft. With only 13 ft. of penetration taken, shows of oil are reported, and the structural condition indicates possible greater saturation below the total depth. The wildcat is located in the Murray Survey, 1 mile southwest of Horn Hill and between Groesbeck and Mart.

In extreme southern Limestone County and in what is called the Kosse area, C. S. Amos and Dawes Harden of Ada, Okla., are preparing to move in rig for the drilling of a Travis Peak test on the R. Hammond fee, on a 4,000-acre block between Kosse and Thornton. Delaney and Osborne Drilling Co. of Ada, Okla., have the contract. The block on which the test is located is the same one assembled in 1926 by the Texas Co. and later dropped. The block is on line along the fault strike with the deep Travis Peak gas and distillate field opened several months ago by Cannon 1 Barron.

Wood County

The source of the water in the Bobby Manziel 1 Morrison, prospective Woodbine sand discovery just north of Hawkins in Wood County, was reported to be above the pay sand. Accurate information on the well lists the following: Originally drilled to 4,925 ft., saturation was logged from 4,902 to 4,920 ft. Casing was set and plug was drilled out to a depth of 4,925 ft. Here only salt water was tested. The hole was plugged back to 4,919 ft. where mostly water still showed. It was then plugged back to 4,894 ft. and drilled out to 4,908 ft. Here the test was allowed to stand over night during which time it filled 800 ft. with salt water. It was drilled out to 4,920 ft. where some oil and gas was detected together with salt water. The entire plug was then drilled out to the old total depth of 4,925 ft. where the test gaged 85 per cent salt water and 15 per cent oil. This led operators to believe the water was coming from above the best zone of oil saturation. Testing continued as the week closed.

Angelina County

New wildcat location for Angelina County was K. L. McHenry 1 William Cameron Lumber Co., located 8,580 ft. from the southwest and 4,620 ft. from the northeast lines of the W. B. Anderson Survey. It is drilling below 1,400 ft. on a 3,500-ft. contract.

New oil completions exceeded pluggings in the East Texas field the last half of October, to reverse the trend set through the summer, the Railroad Commission recently reported.

The field counted 23 new wells the last half of October against 13 abandonments. In the first half of the month pluggings were ahead of completions, and during the full month 32 new oil wells were added.

EAST TEXAS FIELD COMPLETIONS

(1-hour gages)

Gregg County

Longview area: A. McCutchin 4 Jones, 100 bbl., tubing, natural, 3,579-3,599 ft.

Kilgore area: M. T. Flannigan 14 Walker, 40 bbl., tubing, natural, 3,558-64 ft.

Potter Bros. 4 Bagwell-Laird, 28 bbl., tubing, natural, 3,543-94 ft.

Rusk County

Joiner area: Boren 8-A Stoddard, 40 bbl., daily, pumping, 3,535-46 ft.

Sells Pet. 1 Alford, 30 bbl., tubing, natural 3,561-82 ft.

Texas 16-A Jarvis, salt-water disposal well, T.D. 3,844 ft.

EASTERN TEXAS DRILLING REPORT

Anderson County

R. H. & W. Oil 1 Saunders, 17-acre tract in Joseph Ferguson Sur., in Frankston townsite, 5,000-ft. test, S.D. 3,435 ft.

Tex-Harvey Oil 1 Cartmell, 63-acre tract in Blk. 4, E. Ewing Sur., 4 mi. E of Long Lake field, prepare to spud.

Fannin County

H. T. Fleming 1 Welch, E. J. Allen Sur., 4 mi. NW Honey Grove, S.D. 1,200 ft.

Damon Oil 1 A. L. Chaffin, SW cor. 85-acre tract, J. Ketcham Sur., 4 mi. NE Bonham, location cleared, prepare move in materials.

Freestone County

J. L. Collins 1 Utley, Claypool Sur., tested 5 bbl. oil then salt water broke in, S.D. 4,506 ft.

(Continued on Page 245)

This operator installed an O-C-T 2", 6000 lb. test Cylinder Gate Valve on a high pressure gas well in the La Blanca field, January 24, 1940. The well produces hot gas with 4.6 barrels of fluid per 1,000,000 cu. ft. Bottom hole temperature is 237° F., and when the well is "pulled hard" the temperature is 200° F. on the Christmas tree. The O-C-T valve has been opened and closed once a day, under 1900 lbs. pressure, since it was installed, and still makes a positive shut-off, operates freely by hand, and retains its original lubricant.

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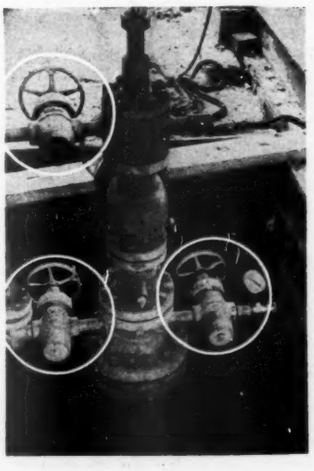
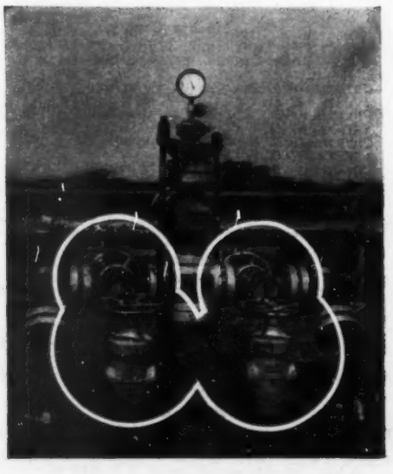


O-C-T 2", 6000 lb. test valves on Christmas tree in the Village, Arkansas, field.

O-C-T 2", 6000 lb. test valves on an input well in the Vanderbilt, Texas, field.



By
STAFF CORRESPONDENT

Knox Co. Clinton Sand Gas Well Best Ohio Completion

NEWARK, Ohio, Nov. 9.—A 4,900,000-cu. ft. gasser in Knox County in the Central Ohio Clinton sand field tops the crop of 20 gas wells completed this week. Nine dry holes and seven small pumpers make up the balance of the completions. The Magnolia Petroleum Co. test in Ashtabula County, Harpersfield Township, is drilling in the lime at 2,100 ft.

In Belmont County, Ohio, the deep test of the Natural Gas Co. of West Virginia on the E. A. Mobley farm, Section 19, Smith Township, drilled through the Oriskany sand which was dry and with no showing of water. The surface elevation is 1,173 ft. with the Oriskany sand topped at 5,651 ft. or 4,478 ft. subsea. The Onondaga lime section was 197 ft. thick. The Oriskany sand was bottomed at 5,700 ft. There is no casing in the hole below the Berea.

These operators will now continue the test to the Clinton sand, the first in the county and it will be of more than usual importance.

Athens County

Ames Twp.: Orndoff 3 C. H. Wooley, Fraction 35, 50,000 cu. ft. gas, second Berea, shot, T.D. 1,455 ft.
Orndoff 3 H. H. Howard, Sec. 34, dry, second Berea missing, T.D. 1,450 ft.
Athens Twp.: F. J. O'Mara 1 Luhrig Coal Co., Lot 172, 50,000 cu. ft. gas, shot, stray 774-830 ft. (Berea water), T.D. 1,105 ft.
Bern Twp.: Jess Williams 1 J. E. Parmiter, Sec. 25, dry, first Cow Run, T.D. 365 ft.
Carthage Twp.: Cooper et al 2 Daniel Ackley, Sec. 16, 800,000 cu. ft. gas, Salt sand, T.D. 1,055 ft.
Ohio Fuel Gas 1 Duane Welsh, Sec. 16, 650,000 cu. ft. gas, Salt sand, T.D. 1,032 ft.
A. D. Townsend 2 W. B. Hartnell, Sec. 2, 250,000 cu. ft. gas, Maxon, T.D. 1,154 ft.

Cuyahoga County

Independence Twp.: L. F. McGrath 2 Mary Buhl, Lot 2, 1,260,000 cu. ft. gas, Newburg 2,730-33 ft.

Guernsey County

Cambridge City: Wharton et al 1 Childrens Home, 40,000 cu. ft. gas, Berea, shot, T.D. 1,160 ft.
Madison Twp.: Dave Ferguson et al E. M. Ogg, Sec. 20, dry, Berea, T.D. 1,352 ft.

Holmes County

Hardy Twp.: Bell Bros. 1 W. W. Badger, Sec. 17, dry, Berea, T.D. 857 ft.
Monroe Twp.: Ohio Fuel 1 W. H. Powers et al, Lot 11, 280,000 cu. ft. gas, Clinton sand, T.D. 3,442 ft.

Jefferson County

Saline Twp.: N. E. Ellis 10 James A. Telfer, SE Sec. 29, dry, Berea, T.D. 1,395 ft.

Knox County

Butler Twp.: Ohio Fuel 2 Albert Wolfe, Sec. 25, 4,900,000 cu. ft. gas, second Clinton 2,955-71 ft.
Union Twp.: H. E. Perkins et al 1 Lewis A. Mickley, SE Sec. 5, 4,000,000 cu. ft. gas, Clinton sand, T.D. 2,775 ft.

Licking County

Mary Ann Twp.: C. A. Davis et al 1 W. H. Weekly, Sec. 15, 210,000 cu. ft. gas, Clinton 2,590-2,616 ft.
Madison Twp.: Ohio Fuel 1 Harry Haynes, Lot 8, second quarter, 10,000 cu. ft. gas, Clinton 2,706-35 ft. (broken), T.D. 2,748 ft., plugged.

Lorain County

Grafton Twp.: Forest Oil Co. 1 C. R. Wells, Lot 89, dry, Berea, T.D. 341 ft.

Medina County

Chatham Twp.: Christman & Sawyer 6 L. A. and Jessie Fusselman, Tract 5, Lot 2, 5 bbl., Berea grit, T.D. 414 ft.
Christman & Sawyer 13 Fusselman, 5 bbl., Berea, T.D. 442 ft.
Christman & Sawyer 19 Fusselman, 5 bbl., Berea, T.D. 397 ft.
Christman & Sawyer 20 Fusselman, 5 bbl., Berea, T.D. 397 ft.
Christmas & Sawyer 1 Fusselman, input, Berea, T.D. 425 ft.
Christman & Sawyer 7 Fusselman, input, Berea, T.D. 381 ft.
Hinckley Twp.: William Dempsey 1 F. T. Wallace, Lot 71, 150,000 cu. ft. gas, Clinton, shot, T.D. 3,442 ft.

Muskingum County

Harrison Twp.: Swingle et al 2 H. M. Stanberry, Sec. 19, 780,000 cu. ft., shot, Clinton 4,060-4,105 ft., T.D. 4,107 ft.

Monroe County

Bethel Twp.: Blair Brothers 3 E. R. Blair, NE Sec. 8, ¼ bbl. before shot, lime, T.D. 1,205 ft.
Sunsbury Twp.: Ferguson et al 1 James Mulligan, Sec. 22, dry, Berea, T.D. 2,002 ft.

Noble County

Beaver Twp.: Ohio Fuel 3 W. H. Ankrom, Sec. 27, 120,000 cu. ft. gas, Berea, T.D. 1,505 ft.
Enoch Twp.: Gerst & Co. 1 Casper Schott, Sec. 27, 5 bbl., Mackburg 500 sand, T.D. 546 ft.
Jackson Twp.: Haga Oil Co. 11 Oris Haga, Sec. 25, 1 bbl., Mackburg 500 sand, T.D. 830 ft.

Perry County

Clayton Twp.: Preston Oil Co. 1 Sarah E. Guest, SW Sec. 7, 2,000,000 cu. ft. gas, Clinton sand, T.D. 3,275 ft., light showing of oil but well will not be shot until gas pressure is depleted.

Stark County

Sugar Creek Twp.: Ohio Fuel 1 E. J. Truby, Sec. 23, 100,000 cu. ft. gas, shot, Oriskany 2,743-54 ft., (Clinton dry), T.D. 4,260 ft.

Washington County

Barlow Twp.: Porter 2 Beatrice Robinson, Sec. 1, 60,000 cu. ft., gas Maxon, T.D. 1,397 ft.
Ludlow Twp.: J. T. Hall et al 1 Henry E. Hall, Sec. 26, 80,000 cu. ft. gas, Berea grit, T.D. 2,088 ft.
H. W. Winland et al 5 H. W. Winland, Sec. 34, 60,000 cu. ft. gas, Berea, T.D. 1,860 ft.
Salem Twp.: Whippoorwill Co. 1 J. Schneider heirs, Lot 64, dry, Gordon, T.D. 2,000 ft.

INDIANA

EVANSVILLE, Ind., Nov. 11.—Out of the 11 wells completed in Indiana during the past week, seven produced a total initial production of 984 bbl. and a 6,700,000-cu. ft. gasser was completed in Spencer County. All but one of the successful oil completions were in Gibson and Posey counties.

The new Vincennes field has two dry holes and a 220-bbl. producer as W. C. McBride completed 1 Metropolitan Life in SW SE NW 24-2n-11w in the McClosky at 1,824-47 ft. Three other wells were in the pay and ready for completion in this pool and two more locations were announced.

The much-publicized Basin Drilling Co. 1 Oakland City College well in SW SE NW 16-8s-14w has been completed as a 112-bbl. pumper in the McClosky at 2,565-82 ft. This well passed up a smaller pay in the Cypress several weeks ago.

INDIANA COMPLETIONS

Gibson County

W. J. Whitcomb 1 Meade.....SE SE SW 12-1s-10w
Dry, T.D. 1,543 ft., deepened from 1,462 ft.
K. T. & F. Oil Co. 1 Shoultz.....NE NE SE 18-1s-9w
Dry, T.D. 1,791 ft., deepened from 1,320 ft.
Griffin Oil 1 Twiggins.....SW NE NE 18-1s-9w
Location abandoned.
Hall Edwards 2-C Maier.....NE SE SE 14-3s-14w
Flowed 200 bbl., 3,000 gal. acid, 2,844-56 ft., T.D. 2,860 ft.
Joe Bander et al 8 Cooper.....NE SW NE 13-3s-14w
Pumped 175 bbl., 30-qt. shot, 2,486-98 ft., T.D. 2,502 ft.

Knox County

W. C. McBride 2 Winckler.....NE SW SW 24-2n-11w
Dry, Ste. Genevieve 1,807 ft., T.D. 1,918 ft.
Dee Miller 2 Sanneman.....SW NE SW 24-2n-11w
Dry, Ste. Genevieve 1,798 ft., water 1,865-68 ft., 1,894-1,902 ft., T.D. 1,906 ft.
W. C. McBride 1 Met. Life Ins. SW SE NW 24-2n-11w
Pumped 220 bbl., 1,500 gal. acid, 1,890-96 ft., 2,000 gal. acid, 1,824-47 ft., T.D. 2,019 ft., P.B. to 1,913 ft.

Porter County

John M. Kavana 1 State Bank NW NE SE 26-36n-7w
Location abandoned.
Roung & Lowe 2 Nielson.....SE NW SE 28-36n-5w
Location abandoned.

Posey County

Somers & Egan 7 Keck.....SE NE NE 34-3s-14w
Pumped 51 bbl., 20-qt. shot, 2,506-26 ft.
J. E. Crosbie 4 Keck.....NW SW NE 34-3s-14w
Pumped 87 bbl. in 13 hr., 2,000 gal. acid, 2,879-87 ft.
W. C. McBride 2 Swanders.....NE NW NE 4-4s-14w
Pumped 139 bbl. in 14 hr., 10-qt. shot, 2,799-2,807 ft.
Bruce Martin 1 Willman.....NW SW NE 8-6s-12w
Location abandoned.
Carl Robinson 2 Spencer.....NE SE SE 26-7s-15w
Rig abandoned.
Basin Drilling Co. 1 Oakland City College.....SW SE NW 16-8s-14w
Pumped 112 bbl., 30-qt. shot, 2,565-82 ft., T.D. 2,687 ft.

Spencer County

Damron Bros. 4 Boyd.....SE SW SE 30-7s-6w
6,701,000 cu. ft. gas, 929-37 ft.

Vanderburg County

Burr Lambert 1 Niederhaus.....SE SE NW 22-4s-10w
Dry, Ste. Genevieve 2,165 ft., McClosky 2,195-2,205 ft., T.D. 2,215 ft.

INDIANA DRILLING REPORT

Benton County

A. C. Thomas 1 Fowler.....NW NW NW 27-25n-9w
Eden 1,015 ft., drilling 1,026 ft.

Daviess County

Newton P. L. 1 Darsan.....NW SW SE 35-2n-5w
Devonian lime 1,879 ft., S.D.
Midwest et al 1-A Dible.....NW NE NE 2-2n-5w
Devonian lime 1,752 ft., drilling 2,000 ft.
Newton P. L. 1 Brittain.....NE NE SW 15-1n-5w
Drilling 2,350 ft.

Gibson County

Loma Oil 1 Brady.....N½ NE NE SW 14-2s-12w
Location, first report.
Mohawk Drlg. 1 Harmon.....NE SE SW 17-3s-11w
Ste. Genevieve 2,427 ft., drilling 2,529 ft.

Greene County

L. B. Jackson 1 Holmes.....NW NW NW 22-7n-6w
Drilling 515 ft.
Commonwealth 1 L. L. Tucker..NE SE NE 16-6n-6w
Drilling 1,618 ft.

Hamilton County

O. H. Hammer 1 Melson.....NE SW SW 13-19n-3e
Drilling 992 ft.
N. N. Smith 1 Pedigo.....NE NE 28-18n-3e
Spud.

Huntington County

G. Beauchamp 1 Mayer Grain..SE NW SW 22-29n-8e
Spud.

Jay County

F. C. Weaver 1 Addington.....SE NE NE 35-24n-12e
Spud.
A. M. Jones 1 White.....NE NE NE 25-24n-12e
Rig.

Knox County

Loma Drlg. Co. 1 Winckler....NW NW NW 25-2n-11w
Swabbed 9 bbl. per hr., 2,000 gal. acid, 4,870-75 ft., T.D. 1,880 ft., putting on pump.
Loma Drlg. Co. 1 Schaller.....SW NW SW 24-2n-11w
Ste. Genevieve 1,799 ft., show of oil 1,874-75 ft., 1,911-14 ft., T.D. 1,922 ft., testing.
Dee Miller 1 Sanneman.....NE NE SW 24-2n-11w
Pay 1,822-28 ft., 1,861-63 ft., 1,890-95 ft., drilling plug.
W. C. McBride 1 Schaller.....SE SE SE 23-2n-11w
Location.
W. C. McBride 2 Met. Met. Life Ins. SW SW NE 24-2n-11w
Location.

Newton County

Vaughn & Smith 1 Boyle.....NE NW NE 5-31n-8w
Drilling 1,060 ft.
Nat. Consumers 1 Tyler.....NE NE NW 4-31n-8w
Rig.

Pike County

P. W. Hart et al 1 Burnett.....SW NW NE 26-2s-8w
Drilling 1,945 ft.

Posey County

H. G. Lewis et el 1 Wolfe.....SW NE SE 25-7s-15w
Golconda 2,290 ft., Ste. Genevieve 2,734 ft., McClosky 2,740-44 ft., to test upper Chester, T.D. 2,744 ft.
R. B. Creager et al 1 Ries.....SE SW NE 1-7s-12w
Menard 1,680 ft., drilling 1,751 ft.

Spencer County

J. Ellis et al 1 Fisher.....E½ SW NE 29-7s-6w
Drilling 1,280 ft.
Doris McPherson 1 Nichols.....SW NW NW 10-8s-6w
Drilling 825 ft.

Steuben County

C. C. Goff 1 Robertson.....SE SE SE 25-36n-13e
Rig.

Sullivan County

S. E. Bailey 1 Wible.....NE NE NW 36-8n-11w
Drilling 815 ft.

Vanderburg County

Weir & Sparrow 1 J. B. Nurrenberg.....NW NE SW 5-7s-11w
Drilling 1,114 ft.

EASTERN KENTUCKY

ASHLAND, Ky., Nov. 11.—While the general operations in eastern Kentucky fail to show much change, oil and gas men's attention remains centered on reports of deep-test drilling in this part of the state. The latest report, coming from sources that have proved authoritative in the past, is that a rotary rig will be moved into the Ezel area in southwestern Morgan County within the next few weeks. This is a development that has been long awaited in eastern Kentucky and the operation will be certain to hold the spotlight.

The Cumberland Petroleum Co. is down 2,507 ft. in shale in the deep test on the L. C. Bailey farm 2 miles west of Oil Springs in Magoffin County. Clinton sand is the stated objective but it is thought possible an effort may be made to hit St. Peter sand.

Floyd Fitch is rigging up for his deep test on Little Caney Creek in Morgan County, 5 miles southwest of West Liberty on the Ezcar Combs farm.

Glenn McCowan et al are moving to a location on the O. M. Stout mineral reserve near the Elk Fork postoffice in Morgan County. It is not definite as to

(Continued on Page 237)

By
DAL DALRYMPLE

Open New Areas in Graham, McPherson, Barton Counties

DISCOVERY of a Mississippian chat oil pool in northeastern McPherson County, Kansas, seemed assured at F. S. Williams and Joe Morine 1 Francis Henne, SW SW NE 21-17-1w. A wildcat in Stafford County was to be tested in Viola lime horizon, and quartzite production in the Orth pool, Rice County, was extended 1 mile northward. Completions of the week included 31 oil wells, 2 gas wells and 11 dry holes.

The 1 Henne topped Kansas City lime at 2,071 ft., set 8-in. at 2,145 ft., topped Mississippi at 2,648 ft., first oil showing at 2,652-55 ft., pay at 2,658-61 ft., total depth, and oil rose 1,700 ft. in the hole in 24 hours. Tanks were being erected, preparatory to acidizing and testing the wildcat for completion. Location is about ½ mile northwest of the town of Roxbury and 2 miles southeast of the Roxbury pool.

Bradley Brothers et al 1-A Davis, W½ SW SW 32-23-12w, about 5 miles east of St. John in Stafford County and southwest of the new Bedford pool, was preparing to test a showing in Viola lime after finding the Arbuckle nonproductive. It topped Arbuckle at 3,972 ft., total depth 3,987 ft., and set 5-in. casing at 3,804 ft. Viola lime was topped at 3,799 ft., and best showings of oil were logged at 3,850-60 ft.

Estimated Daily Production

Estimated daily production for Kansas for the week ended November 9, and for the preceding week, was as follows:

	Barrels	
	Nov. 9	Nov. 2
Oxford City	750	750
Burrton	7,200	7,100
Ritz-Canton	3,850	4,100
Graber	2,700	2,750
Hollow-Nikkel	1,450	1,500
Lerado	700	650
Voshell	1,750	1,650
Wellington	1,350	1,650
Ellsworth County:		
Lorraine	1,000	1,050
Other pools	4,030	4,660
Rice-Barton counties:		
Bloomer	3,250	4,300
Chase	3,550	4,150
Geneseo	3,850	3,550
Raymond	650	600
Silica	11,900	14,500
Keesling	650	900
Wherry	2,950	3,200
Miscellaneous Barton	5,060	5,280
Trapp district	11,050	14,450
Balance Russell County	17,250	18,300
Sedgwick County	3,200	3,150
Ellis County:		
Bemis	8,350	6,850
Burnett	5,300	6,000
Miscellaneous	2,435	2,655
Kingman County	675	860
Stafford County	6,430	7,895
Greenwood County	8,350	8,250
El Dorado	7,100	7,050
Other fields	42,170	44,900
Total Kansas	168,950	182,700

Pre-Cambrian quartzite production in the Orth area, Rice County, was extended about 1 mile northward at W. N. Bartlett et al 1 Bierberle, SE SW 22-18-10w. Quartzite was found at 3,148-3,201 ft., total depth. It was reported to have made temporary potential of 72 bbl. of oil and completed for minimum well. Other production in the area is from Lansing lime.

A new productive area was found in Graham County at R. W. Shields et al 1 Paxson, NE NE NE 11-8s-24w, 7 miles northwest of Hill City. It had Lansing lime at 3,558 ft., cherty conglomerate 3,940 ft., Arbuckle zone 3,965 ft., total depth 4,104 ft., with nothing showing. Five-inch casing was set at 3,823 ft., perforated at 3,740-50 ft. and 3,750-56 ft. It was acidized, oil rose 2,000 ft. in the hole, and refills at the rate of 4 bbl. an hour. Gravity of the oil is 34.5°, corrected. Nearest production is 22 miles to the southeast in the Morel pool.

The Prusa pool in Barton County was extended ½ mile eastward at Armer et al 1 Ney, S½ SW NE 17-16-11w. It made potential of 69 bbl. daily from Topeka lime.

A gas discovery well was completed in McPherson County, about 3 miles east of the Ritz-Canton field, at E. K. Carey et al 1 Coons, W½ SW SW 13-19-1w.

KANSAS COMPLETIONS

Barton County

Kraft pool: Darby 4 Burmeister, CEL SE SE 3-17-11w, T.D. 3,295 ft. in Arbuckle, acidized, potential 2,201 bbl., calculated.

Derby 4 Frees, SW NW NE 3-17-11w, T.D. 3,374 ft., swabbed 9 bbl. of oil an hour naturally from Arbuckle, acidized, potential 250 bbl.

Prusa pool: Derby 1 Bernsdorf-Janke, NW NW NE 33-16-11w, T.D. 3,362 ft. in Arbuckle, potential 3,000 bbl., calculated.

Shell 2 Oeser, NE NE SW 17-16-11w, T.D. 3,316 ft. in Arbuckle, acidized, potential 1,005 bbl., calculated.

Armer et al 1 Ney, S½ SW NE 17-16-11w, T.D. 2,815 ft. in Topeka, acidized, potential 69 bbl., pumping.

Trapp field: Cities Service 7 Bitter, CSL SE NW 5-16-13w, T.D. 3,363 ft. in Arbuckle, acidized, potential 3,000 bbl., calculated.

Phillips 8 Bitter, CWL SW NE 6-16-13w, T.D. 3,359 ft. in Arbuckle, acidized, potential 1,688 bbl., calculated.

Cowley County

Rock pool: Arthur Brewer 3-C Starkey, NE SE SE 19-30-4, Bartlesville sand 2,742 ft., T.D. 2,786 ft. in sand, pumped 332 bbl. daily, extending pool southwestward.

Ellis County

Bemis field: Sinclair Prairie 2-A Cress, CEL SW SW 18-11-16w, on the southeast side of the Cress sector of the field, Arbuckle 3,418 ft., T.D. 3,428 ft., dry.

Burnett field: Dickey Oil 5 Husted, CNL SE SW 18-11-17w, T.D. 3,347 ft. in Arbuckle, potential 3,000 bbl., calculated.

Phillips 6 Sites, SW NW 12-11-18w, T.D. 3,351 ft. in Arbuckle, swabbed 78 bbl. daily.

L. H. Wentz 2 Riddler, N½ SW SW 1-11-18w, T.D. 3,529 ft. in Arbuckle, acidized, potential 173 bbl., pumping.

Sander pool: Gulf 1 Alex, SE SE 30-13-16w, west of the new Sander pool, T.D. 3,497 ft., dry.

Wildcat: Lario O. & G. 1 Slimmer, W½ NW NW 12-11-17w, Topeka 2,815 ft., Sooy 3,341 ft., Simpson 3,468 ft., Arbuckle 3,495 ft., T.D. 3,530 ft., dry.

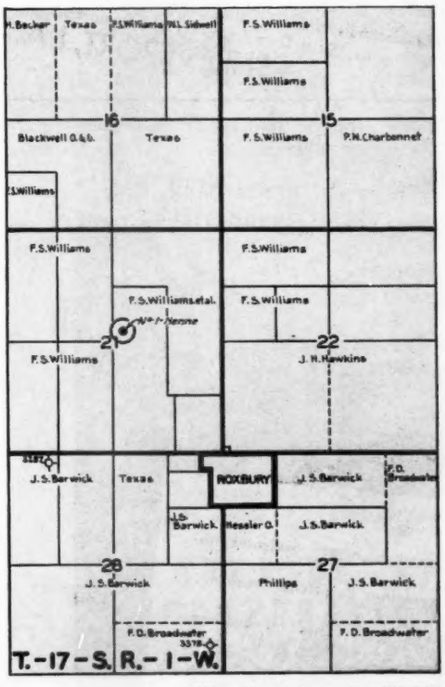
Ellsworth County

Edwards pool: Continental 3-A Johnson, CEL SE SE 28-17-8w, T.D. 3,258 ft. in Arbuckle, acidized, potential 2,266 bbl., calculated.

Stoltenberg district: I. T. I. O. 2 Boye, S½ NE NW 16-16-10w, T.D. 3,343 ft. in Arbuckle, dry.

Lario 6 Mehl, CNL SW NE 35-16-10w, Arbuckle 3,279 ft., set 5-in. 3,280 ft., T.D. 3,281 ft., acidized, potential 3,000 bbl., calculated.

Jayhawk Oil 1 Haska, CSL SE 5-16-10w, T.D. 3,285 ft. in Arbuckle, acidized, potential 2,265 ft., calculated.



Midcontinent Map Co., Wichita

A chat oil pool has been opened in northeastern McPherson County at F. S. Williams et al 1 Henne, 21-17-1w, northwest of Roxbury. It is about 2 miles southeast of the Roxbury pool. It was to be acidized before completing

Greenwood County

North Virgil pool: O. F. Duncan 3-A Fankhouser, NE NW SW 20-23-13, T.D. 1,818 ft., dry.

Severy pool: Roscoe Mendenhall 2 Souders, NE SE NE 5-28-11, T.D. 1,272 ft., pumped 5 bbl.

Lemon & Shewmaker 1 Cope, NE SE SW 17-28-11, T.D. 1,229 ft., pumped 25 bbl.

Lemon et al 1 Shell estate, NE SW NE NW 17-28-11, T.D. 1,230 ft., pumped 30 bbl.

Thrall-Agard area: P. J. McIntyre et al 2 Agard, SE NE NE 23-24-9, T.D. 2,366 ft., dry.

Kingman County

Cunningham field: Skelly 1-D Miles, CSL NE 13-27-10w, Gaged 50,200,000 cu. ft. of gas after acidizing Viola lime with 1,000 gal., T.D. 4,071 ft.

McPherson County

Bornholdt field: W. H. Moulton 4 Bornholdt, S½ NW SE 30-20-5w, T.D. 3,365 ft. in chat, was acidized and retested, making new potential of 3,000 bbl., calculated.

H. C. Bennett 4 Knackstedt, CSL NW SW 30-20-5w, T.D. 3,361 ft. in chat, pumped 47 bbl., completed for minimum well.

Transwestern 3 Peterson, CEL NW SE 18-20-5w, Chat 3,289 ft., T.D. 3,323 ft., potential 3,000 bbl., calculated.

Roxbury pool: Bay Pet. 1 Zietlow, CWL NE NE 19-17-1w, T.D. 2,660 ft. in chat, potential 1,432 bbl., pumping.

Westgate-Greenland 1 Zietlow, E½ SW NE 19-17-1w, T.D. 2,667 ft. in chat, potential 2,106 bbl. pumping.

Wildcat: E. K. Carey Drlg. et al 1 Coons, W½ SW SW 13-19-1w, about 3 miles east of Ritz-Canton pool, Mississippi 2,896 ft., T.D. 3,425 ft., P.B. 2,917 ft., perf. at 2,897-2,910 ft., gas est. at 3,000,000 cu. ft.

Reno County

Burrton field: Olson Oil 9 Blake, SW NE SW 23-23-4w, Retested after acidizing in chat, T.D. 3,414 ft., pumped 95 bbl.

Barnsdall 3-B Sabin, SW NW NE 11-23-4w, Retested after acidizing in chat, T.D. 3,374 ft., pumped 246 bbl.

Rice County

Orth pool: W. N. Bartlett 1 Bierberle, SE SE SW 22-18-10w, T.D. 3,201 ft. in quartzite, temporary initial potential 72 bbl., pumping, completed for minimum well.

Silica field: W. N. Bartlett 2 Houston Community, SE NW SW 19-20-10w, T.D. 3,271 ft. in Arbuckle acidized, potential 3,000 bbl., calculated.

Wildcat: George W. Hinkle et al 1 Goodwin, SW cor. 2-18-8w, about 1 mile from both the Edwards and Geneseo pools. Arbuckle 3,290 ft., T.D. 3,305 ft., dry.

Rush County

Albert pool: Schermerhorn 4 Schroeder, CNL NE 36-18-16w, T.D. 3,601 ft. in basal Cambrian sand, potential 498 bbl., pumping.

Russell County

Big Creek pool: H. H. Blair 9 Harbaugh, CNL S½ SW 25-14-15w, Kansas City 2,935 ft., Conglomerate 3,171 ft., Arbuckle 3,174 ft., T.D. 3,177 ft., potential 3,131 bbl., pumping.

Hall-Gurney field: Cities Service 4 Carter, CNL SE NE 29-14-13w, T.D. 3,168 ft. in Lansing, acidized, potential 1,438 bbl., calculated.

Mid-Continent Pet. 2 Schaffer, N½ SW 35-14-13w, T.D. 3,192 ft., dry.

Trapp field: Coralena Oil 3 Sellens, CSL SE SE 19-15-13w, T.D. 3,044 ft. in Lansing, potential 357 bbl., pumping.

Shell 3 Sellens, SW NW SW 33-15-13w, T.D. 3,338 ft. in Arbuckle, potential 3,000 bbl., calculated.

Wildcat: J. R. Robertson et al 1 Radke, S½ SE SW 18-15-14w, Sooy 3,415 ft., Arbuckle 3,420 ft., T.D. 3,442 ft., dry.

Sedgwick County

Martin area: I. W. Murfin et al 1 Vilm, NW NE 18-28-1e, north of the Martin pool, T.D. 3,626 ft., dry.

Stafford County

Bedford pool: Shell 2 Bean, NW SE SW 21-23-12w, T.D. 3,870 ft. in Arbuckle, swabbed 337 bbl. daily.

South Snider area: Champlin 2-A Smith, CWL SE NE 17-21-11w, T.D. 3,425 ft. in Simpson, pumped 168 bbl.

Zenith field: A. M. Landon 3 Equitable, SE NW NE 15-24-11w, T.D. 3,826 ft., potential 1,562 bbl. daily, pumping from Misener and Viola pays.

Woodson County

Hoagland area: Cook & Huddleston 1 Hoffmayer, NE NE NW 23-23-14, T.D. 1,643 ft., dry.

WILDCAT REPORTS

Barber County

Barbara Oil 1 Angell ..... CNE SE 10-33-14z
T.D. 5,078 ft., cementing 5,121-31 ft.

Barton County

Owens et al 1 Burmeister..... CS½ SE NW 20-17-11w
Drilling 1,605 ft.

Continental 1 Borger NW SW NE 33-16-14w
Topeka 2,852 ft., drilling 3,220 ft.

Cowley County

Wakefield et al 1 Durham ..... CW½ NW SE 34-30-3
Drilling 380 ft.
Shell 1 O'Neil ..... NE cor. 27-32-3
Layton 2,492 ft., Kansas City 2,595 ft., Stains 2,631-44 ft., 2,672 ft., 2,703 ft., 2,714 ft., Oswego 2,842 ft., Bartlesville 3,040 ft., Mississippi lime 3,112 ft., drilling 3,152 ft.

Douglas County

Douglas County O. & G. Syn. 2 Gago NE cor. 11-13-20
Mississippi lime 1,104-40 ft., T.D., no shows.

Ellis County

Lario O. & G. 1 Patter.....CW½ NW SW 20-11-16w
Fort Riley 1,875 ft., Lansing 3,065 ft., drilling 3,265 ft.

Edwards County

McKnab et al 1 Minet ..... CSW SW 15-25-17w
Base Florence 2,550 ft., Fort Riley 2,410 ft., drilling 3,450 ft.

Graham County

R. W. Shields 1 Paxson .. .. NE cor. 11-8-24w
Set 5-in. casing 3,823 ft., cleaning out to 3,760 ft., perf. 3,750-56 ft., acidized, pumps 4 bbl. oil per hr.

Greenwood County

E. W. Creel et al 1 Stonebreaker..... CW½ E½ SW 32-27-11
Drilling 1,160 ft.
Ward McGinnis 1 Sharp C SW SW 9-28-12
Underreaming 6-in. casing 1,647 ft.

Jewell County

Gulf 1 Houghton ..... CS½ SW NW 10-4-10w
Drilling 3,292 ft.

Leavenworth County

McLaughlin & Sons 1 Thorp.....CNE NE 27-10-20
Drilling 400 ft.

McPherson County

F. S. Williams et al 1 Henne.....SW SW NE 21-17-1w
Mississippi lime 2,648 ft., pay 2,658-61 ft., T.D. 6-in. casing, stuck 2,655 ft.

Nemaha County

A. C. Bumpus et al 1 Achten.....12-4-14
S.D. 1,870 ft.

Rice County

Cities Service Gas 1 Hilt.....CSE 15-19-8w
Base Kansas City 3,170 ft., Sooy 3,217 ft., Arbuckle lime 3,317-25 ft., rigging up standard tools 3,325 ft.
R. E. Hess et al 1 Cole .....SE SE NE 31-20-6w
Set 8-in. casing 2,370 ft., fishing 2,385 ft.

Rooks County

Palmer Oil 1 Denio.....CE½ SW NE 17-8-16w
Drilling 1,162 ft.

Russell County

Pryor & Lockhart 1 Borrell.....CN½ NE SE 3-15-11w
Drilling 700 ft.
Braden & McClure 1 Phillip.....CN½ NW SE 34-15-11w
Estimated 500,000 cu. ft. gas at 1,630-35 ft., drilling 2,020 ft.

Stafford County

Bradley Bros. 1-A Davis.....CW½ SW SW 32-23-12w
Ft. Riley 1,885 ft., Florence 1,980 ft., Topeka 2,985 ft., Lansing lime 3,475 ft., Sooy 3,760 ft., Viola 3,799 ft., drilling 3,899 ft.

Sumner County

Shawver & Carter Oil 1 Knowlton..CW½ NW SE 6-33-2
Drilling 1,569 ft.

Thomas County

Alva Billings 1 Ryan.....CE½ NE SE 27-8-32w
Drilling 400 ft.

FIRST REPORTS

Atchison County

Cities Service 1 Johnston, wildcat SW SW NE 5-6s-19e

Barton County

Shell 1 Homolka, wildcat ..... NE NE SE 24-16-11w
W. O. Allen et al 1 Benjamin, wildcat ... W½ SW SE 3-19-13w

Brown County

Ladd & Vincent et al 1 Bruce, wildcat E½ SE SE 15-3s-15e

Butler County

Blakeslie et al 2-A Wilson ..... SW SW NE 28-27-4
Bergman et al 2 McKinley ..... NE NE SE 19-29-4
Davies & Elson 1-A Maxwell ..... NW SE SW 31-24-4

Cowley County

Derby Oil 4 David ..... NW SE NE 2-31-4

Ellis County

Dickey Oil 1-C Henderson .... W½ NW NW 6-11-17w

Greenwood County

Oko Oil 6-A Weirshing ..... C NW NW 24-26-9

Jefferson County

Caufield & Sullivan 1 Ragan, wildcat SW SW SE 19-10-20

Johnson County

McCain, Sherrod et al 1 Doan, wildcat E½ NW SE 34-12-22

Rice County

Shell et al 1 Reece ..... NW NW NW 16-19-9w

Rooks County

Co-Operative 5 Beardmore .. CSL NE NE 10-9-16w
Cities Service 1 Johnston ..... SW SW NE 5-6-19w

Russell County

Coralena Oil 1 Meharg ..... SE NE SE 18-15-13w

Scott County

Atlantic 1 Hamlin ..... CWL SW SW 11-20-33w

Sherman County

W. A. Rezeau 1 Feaster ..... CEL SW SW 18-8-39w

Thomas County

Alva Billings et al 1 Ryan, wildcat ..... CEL NE SE 27-8s-32w

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Forest City Basin

ST. JOSEPH, Mo., Nov. 11.—Twenty-two producers have been completed in the Falls City, Neb., oil pool, Richardson County. During this week the twenty-third will be completed in the pool. Observers look for the market to jump soon from approximately 3,000 bbl. to 7,500 bbl. daily. The Nebraska Producing & Refining Co. refinery at Salem, which will have a 2,000-bbl. capacity, is 95 per cent completed and work is going ahead on the 2,500-bbl. Mid States Refining Co. plant at Falls City.

The last well completed in the pool was the Midland Oil Co. 1 Towle, NE NW NW 29-1n-16e, Richardson County. On a 12-hour pumping test the well produced 160 bbl.; water content 0.4 per cent. No acid has been applied. Hunton pay was topped at 2,362 ft. and drilled about 2 ft.

Next to come in will be R. L. Campbell 2 William Schock, C S½ NE SE 20-1n-16e. Pipe was cemented after a saturated core was pulled in the Hunton at 2,260 ft. This well is on a Phillips farmout and is the third drilled by Campbell and his St. Joseph associates. Location for the fourth well is in SW SE SW 20-1n-16e, the No. 2 Dora Schock. E. J. Shaffer of Hutchinson, Kans., has contracted for all the wells by this group.

Skelly Oil Co., in deepening 1 Prichard after a Hunton lime failure in C SE NE 28-1n-16e, on the south edge of the pool, had trouble with frozen drill pipe. At the end of the week the difficulty had not been removed. Depth was a little below 2,500 ft. Skelly now is drilling 3 Davisson, SE NW NE 20-1n-16e.

E. J. Shaffer was having trouble with water at his 2 Sandrock, N½ NE NW SW 20-1n-16e. The well swabbed 300-400 bbl. of oil daily with 20 per cent water. Possibly the water is coming from another well in the vicinity as Shaffer's is not the only well with the trouble. Shaffer 3 Sandrock, NW SW NW 20-1n-16e, was drilling below 500 ft.

Pawnee Royalty Co. 3 Bucholz in 17-1-16e was the highest well in the field, topping Hunton at 2,208 ft.; elevation 896 ft.

Jackson & Rust 1 Eickhoff, NE NW 4-21n-16e, was abandoned at total depth of 2,530 ft. Hunton lime topped at 2,508 ft. was acidized twice, bringing a small quantity of oil and much water. The Indian Territory Illuminating Oil Co. 1 Bankers Life in NE SE 3-2n-16e, Richardson County, was temporarily abandoned as rig was taken away. Some oil and much water was found in the Hunton, which was topped at 2,418 ft., drilled to 2,476 ft., plugged back to 2,448 ft., acidized and shot.

Nemaha Development Corp. 1 Evans in C NW NE 32-5n-15e, Nemaha County, Nebraska, was dry and abandoned at 3,502 ft. Hunton was topped at 2,218 ft., Viola at 2,994 ft. and Arbuckle at 3,428 ft.

Pulliam & Gall 1 Lawrence in SE SE SE 34-5n-15e. Nemaha County, was drilling in Mississippi lime below 2,010 ft. Elevation is 919 ft.

The Kansas Sector

In the Kansas area of the Forest City basin Ladd, Vincent & Gernon 1 Bruce in C E½ SE 15-3s-15e, Brown County, was rigging up to spud. Ladd & Vincent were underreaming 8-in. pipe at their 1 Achten in CSL SE NW 12-4s-14e, Nemaha County. Depth was approximately 2,000 ft.

In Missouri, American Gas & Oil Co. 1 Thompson, SW SW 20-58n-31w, DeKalb County, was near completion. Viola lime was topped at 1,915 ft.

In Iowa, W. O. Smythe et al 1 Hook, NE NW 18-69n-35w, Taylor County, set 10-in. casing at 720 ft. and drilled to 1,100 ft. In running 8-in. crew discovered that 10-in. pipe had collapsed.

NEBRASKA COMPLETIONS

Richardson County

I. T. I. O. 1 Bankers Life ..... C NE SE 3-2-15
T.D. 2,476 ft., 6 bbl. water, plugged back 2,444 ft., shot, cored oil at 2,431 ft., acidized and the hole filled with water, temporarily abandoned.

Nemaha County

Nemaha Development Co. 1 Evans C NW NE 32-5-15
St. Peter 3,387 ft., Arbuckle 3,427-3,510 ft., T.D., dry.

NEBRASKA WILDCATS

Cass County

Golden Rod Oil 1 Sporrer ..... SE cor. 8-11-13
Bartlesville 390 ft., show oil, Mississippi lime 400 ft., Viola 1,020 ft., drilling 1,265 ft.

Furnas County

Trickett & Atkins 1 Gossic ..... NW cor. 33-2-21w
Shut down at T.D. 742 ft.

Keith County

Keys et al 1 Haythorn ..... C SW 27-16-39w
Ogallala 172 ft., Brule 550 ft., Chadron 770 ft., set 8-in. casing at 810 ft. and S.D.

Lancaster County

August Krueger 1 Roe ..... SE SW SW 5-7-7
Drilling 720 ft.

Nemaha County

Frank Engles 1 Wheeler ..... NE cor. 9-4-14
Underreaming 8-in. casing at 2,388 ft.
Bow & Arrow Oil 1 Shriefer ..... C N½ NE SW 20-5-14
8-in. casing 1,900 ft., S.D. 2,000 ft.

Richardson County

Eckhart et al 1 Ast ..... SW SW NW 6-1-14
Drilling 1,400 ft.
Uhri Oil 1 Ogle ..... NW SE SE 9-1-14
T.D. 2,260 ft., pumping 130 bbl. oil and some water per day.
Forest City Basin Synd. 1 Windle-Dodge SE NE SE 3-1-15
Hunton 2,565 ft., shut down 2,605 ft.
R. McIntyre et al 1 Hough-Hill ..... C SE SW 6-1-16
Drilling 1,800 ft.
Jackson et al 1 Eickhoff ..... C NE NW 4-2-16
T.D. 2,550 ft., show oil.

FIRST REPORTS

Nemaha County

Wildcat: Palonski et al 1 Dolhke..... C NE NE 14-3-12
Wildcat: Francis Krone 1 Morehead... C NE SW 35-4-16

Pawnee County

Black Gold 1 Hauner ..... C NW NE 31-3-11

Richardson County

E. J. Shaffer 3 Sandrock ..... NW NW SW 20-1-16
Skelly 1 Pritchard ..... C SE NE 29-1-16
Old T.D. 2,401 ft. in Hunton, fishing 2,887 ft.

IOWA

Fremont County

J. A. Johnson et al 1 Lucas..... SW NE SE 28-70-43w

MISSOURI

Randolph County

Randolph Drlg. 1 Tregnargo .... C SE NE 33-53-14w

MISSOURI WILDCATS

De Kalb County

A. & W. Oil & Gas 1 Pickett....NW NW SE 13-57-32w
Spudding.
American O. & G. 1 Thompson C SW SW 30-58-31w
Hunton 1,560 ft., basal Devonian sand 1,899 ft., drilling 1,910 ft.

Holt County

Flory & Kilby 1 Meyer.....SE NE NW 27-62-39w
S.D. 70 ft.

Knox County

Harris & Holmes 1 Newkirk.....NE cor. 11-61-11w
Mississippi lime 200 ft., 8-in. casing 200 ft., cleaning out 300 ft.

Livingston County

Fred Jones et al 1 Kesler.....SE SE SW 16-59-25w
S.D. 604 ft.

Kentucky Fields

(Continued from Page 234)

the deep-test intentions in this operation but with the present trend in eastern Kentucky operators are watching other activities closely.

Oliver Jenkins, drilling on the Rolla Dixon farm on the headwaters of the Open Fork of Paint Creek, has shut down at the 668-ft. mark, through the Big lime, in another Morgan County operation.

WESTERN KENTUCKY

OWENSBORO, Ky., Nov. 11.—Six oil wells and six dry holes were completed in western Kentucky during the past week. All of the producers were small, the best being a 50-bbl. McClosky well in Bluff City, Henderson County.

Daviess County

Handyville dist.: Staves 4 L. T. Igleheart, 10 bbl., Jett sand, drilled deeper from 1,292 ft. to 1,300 ft., 80-qt. shot, 1,280-1,300 ft.
Vickers 4 William Johnson, abandoned location.
Utica dist.: Hupp 2 Stevens, 30 bbl., 30-qt. shot, Barlow sand 1,355-63 ft., T.D. 1,383 ft.
Farmer 4 J. E. Brown, 10 bbl., 60-qt. shot, Jones sand 1,350-70 ft., T.D. 1,429 ft., P.B. to 1,287 ft.

Hancock County

Lyonia dist.: Moore & Fields 8 G. W. Roby, dry through Jett sand, T.D. 484 ft.

Henderson County

Hebbardsville dist.: Jack Cox 1 George F. Priest, dry through Jett sand, T.D. 1,509 ft.
Bluff City dist.: C. Lautenslager 1 W. D. Fulton, 50 bbl., 1,000 gal. acid, McClosky 2,100-05 ft.

Hopkins County

Hamby Station dist.: H. L. Scott 1 Schwab, dry, T.D. 940 ft.

McLean County

Island dist.: South Penn 11 Alma Nall, 15 bbl., 80-qt. shot, Jett sand 1,427-52 ft., T.D. 1,457 ft.

Muhlenberg County

Belton dist.: C. T. Judd 1 Cora McKinney, 150,000 cu. ft. gas, Jett sand 800-05 ft., T.D. 940 ft.

Ohio County

Friendship Church dist.: Mayer 5 R. J. Brannon, dry, T.D. 972 ft.
Sunnydale dist.: Tuttie 12 Lena Berry, dry, T.D. 190 ft.
Taffy dist.: DeHart & Hunt 7 L. T. Bartlett, est. 5 bbl., stray sand 528-40 ft., T.D. 546 ft.

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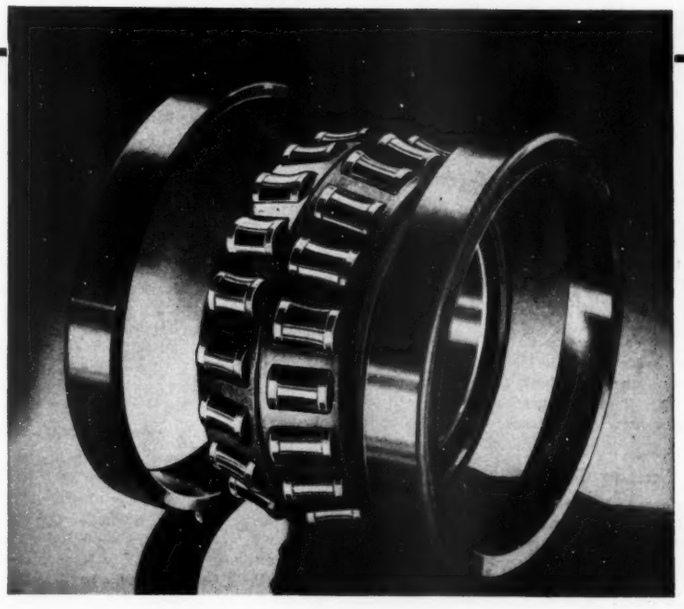

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SOUTHWEST TEXAS

By

F. L. SINGLETON

Agua Dulce Extended East; New Sand North of Shield

CORPUS CHRISTI, Tex., Nov. 11.—An increase in development along the southeast flank of the Agua Dulce field, Nueces County, is anticipated following the completion of Richardson Petroleum Co. 1 Guaranty Title & Trust Co., which extended oil production about 3,000 ft. east when it flowed 48 bbl. in 12 hours through a ¼-in. choke under a tubing pressure of 1,750 lb. and shut-in casing pressure of 2,250 lb. The well was drilled to a total depth of 7,209 ft. and was completed in the newly opened sand at 6,889-95 ft. The well is located in Section 305, F. Z. Bishop subdivision, due east of the company's No. 2 McCoy, which opened crude production in this area several weeks ago. About 1 mile southeast of the McCoy well, drilling was started on S. E. W. Oil Co. 1 Pfluger in Section 186, Bishop Palo subdivision.

Distillate production from a new sand was opened in an outpost well, 4,700 ft. north of the Shield field, Nueces County, as Shield Oil Co. 1 Allen was flowing an estimated 50 bbl. of distillate per day and a large volume of gas while testing through perforated casing at 6,970-74 ft. Tubing pressure was 2,400 lb., and casing pressure 2,525 lb. The well was completed at the present depth after testing salt water in a deeper sand at 7,500 ft.

East Flour Bluff Extension

Humble Oil & Refining Co. extended production in the East Flour Bluff field, Nueces County, with the completion of two wells. No. 4 State flowed 181 bbl. per day through a ⅛-in. choke from sand at 6,799-6,807 ft., while 2-E State flowed 171 bbl. per day through a ⅛-in. choke from sand at 6,788-96 ft. The company's 1-G State cored sand and sandy shale with an oil show at 6,703-78 ft., the total depth, and 5½-in. casing was cemented on bottom.

Nueces County continues to be the most active area in the district, with the majority of the development centering around the east flank of the Stratton and South Clara Driscoll fields, where extensions and new sand discoveries have been recorded in the past few months.

Orange Grove District

Three miles east of Orange Grove, Jim Wells County, H. R. Smith 1 Kohler cemented casing at 5,129 ft., and the well is scheduled to test sand at 5,049-65 ft., where drill-stem testing showed several hundred pounds working pressure and a small amount of distillate. Southeast of Orange Grove, and due west of the discovery well of the Henshaw field, Henshaw Brothers 1 Boerner is bottomed at 5,885 ft. and 5½-in. casing was cemented at 5,300 ft., preparatory to completing as a gas well, after it failed to core saturation in the discovery pay. Two wildcats were marked up as failures. In the Magnolia City townsite, Seaboard Oil Co. 1 Cohn was abandoned at a total depth of 6,295 ft. The well attempted to blow out the previous week, but an electrical survey failed to show any sand section worth testing. Eight miles northeast of Alice, Charles Daubert and McBride 1 True was abandoned at a total depth of 5,608 ft. Slight showings were logged at 5,500-81 ft., but drill-stem testing failed to develop anything of commercial importance.

Nichols Field Opened

The new producing area opened about 1½ miles east of the Samfordyce field, Hidalgo County, has been named the "Nichols" field. The area was opened the previous week by the completion of Royal Oil & Gas Co. 1-A Yturria Town & Improvement Co., which was officially gaged at the rate of 86 bbl. per day through a 9/64-in. choke. The well was drilled to a total depth of 3,553 ft., and production was obtained by perforating casing at 3,497-3,503 ft. The area is separated from the Samfordyce structure by a fault which has been traced in a northeast-southwest direction.

Duck Bay Field

The Duck Bay field, Calhoun County, was extended 1,425 ft. eastward with the completion of Coronado Corp. 9-A Welder, completed through perforated casing at 5,660-61 ft. for an estimated daily production of 65 bbl. flowing through a 3/32-in. choke.

Casing pressure was 1,370 lb. and total depth 6,025 ft. The field was opened in July by Coronado 1 Katherine Welder completed at 10,008 ft. in sand at 5,645-59 ft. for a commercial well of 36.4-gravity oil. The field is 3 miles southeast of Seadrift.

Rio Grande Valley

In the Rio Grande Valley district, Pan American Production Co. and Shell Oil Co., Inc., 1 Garcia, Willacy County, showed promise of opening a new field as it swabs through perforated casing at 7,668-78 ft. Approximately ½ bbl. of fluid is recovered on each swab, 10 per cent of which is salt water and the balance 30-gravity oil. The fluid is standing 3,000 ft. from the top, and it is reported that the fluid cannot be lowered by swabbing. Added attraction was given the area with the announcement of a new location which will be drilled jointly by the two companies. The well is No. 1-B Garcia, situated about 5 miles south of the present well in Share 13 of the San Juan de Carricitos grant.

In Cameron County and located 5 miles northeast of Falfurrias West Production Co. 1 Ehlers is shut down for repairs at 7,871 ft., and continues to log showings of gas. A drill stem test at 7,791-7,800 ft., recovered salt water with a show of distillate, and working pressure built up to 230 lb.

I. K. Howeth 1 Kreis, reported the previous week as a probable pool opener for Duval County, has been completed for a small pumper. The well was completed through perforated casing at 3,249-68 ft. and is reported to be pumping an estimated 25 bbl. of 29-gravity oil per day. The well is located in the L. Gunter Survey 68, about 16 miles northwest of the town of San Diego.

Weser Area

Considerable interest was attracted to the Weser area, Goliad County, by the showing of W. R. Davis Co., Inc., 1 W. F. Albrecht which is preparing for a production test after a drill-stem test in the Cook Mountain formation at 5,242-55 ft., recovered 930 ft. of pipe-line oil in 17 minutes. This field was opened in 1936 by California Co. 1 Langrebe, completed in the Yegua sand at 4,797-4,807 ft. for an initial production of 300 bbl. of 47-gravity oil per day through a ¼-in. choke. Two wells, drilled in 1938 and 1939 by Steinberger Petroleum Corp. and Martex Oil Co., failed to find production in the Yegua sand, and were completed as distillate producers in the Cook Mountain sand at 5,232-45 ft. The present well is located in the Thomas Hancock Survey about 800 ft. northwest of Steinberger 1 Albrecht.

In La Salle County and located in the Washburn field, H. R. Cullen 2 Washburn, 4,500 ft. northeast of the discovery well, is shut down at a total depth of 4,983 ft. Sand and shale with an oil odor was cored at 4,500-4,700, 4,683-4,718, 4,718-28, and 4,728-83 ft. The well is reported to be checking about 80 ft. structurally higher than the discovery well, and if this is true, it appears that the producing section of the discovery well is practically shaled out.

Wilcox Trend Play

Leasing along the Wilcox trend continues active and several interesting wildcats are expected to be drilled in the area after the first of the year. In De Witt County, Stanolind Oil & Gas Co. is reported to have assembled a block of several thousand acres near the townsite of Meyersville in southeastern De Witt County, centering in the C. Armster and J. Jones, and Luken Mason Surveys.

SOUTHWEST TEXAS DRILLING REPORT

Bee County

Magnolia 1 Page, projected 4,000-ft. Pettus sand test, W. T. Evans Sur., first report.

Live Oak County

Danciger 1 San Antonio Joint Stock & Land Co., 2 mi. W of Three Rivers, Thomas Henry Sur., first report.

Nueces County

F. A. Gillespie 1 D. W. Dabney, G. H. Paul Subd., drilling shale 5,730 ft.

Zavala County

R. E. McClung 1 Munger ranch, 9 mi. SW of La Pryor, I.&G.N. Sur. 41, drilling shale 2,835 ft.

SOUTHWEST TEXAS COMPLETIONS

LOWER GULF COAST DISTRICT

Goliad County

Fannin field: Renwar 1 Swickheimer, dry, T.D. 5,006 ft.

Jim Wells County

Sandia field: O. W. Killam 13 Wade, dry, T.D. 5,203 ft.
Wade City field: Anderson-Prichard 6 Mueller, 157 bbl., 9/64-in. choke, perf. casing 4,790-92 ft., T.D. 4,920 ft.
Arkansas Fuel 5 Sachtlehen, 175 bbl., 5/32-in. choke, perf. casing 4,900-06 ft., T.D. 4,921 ft.
Atlantic 1 Laging, 5 bbl., 5/64-in. choke, perf. casing 4,790-91½ ft., T.D. 4,799 ft.
Magnolia 5 Schmidt, 92 bbl., 7/64-in. choke, perf. casing 4,914-16 ft., T.D. 4,934 ft.

Nueces County

East Flour Bluff field: Humble 3-D State, 117 bbl., ⅛-in. choke, T.D. 6,831 ft.
Humble 5-D State, 148 bbl., ⅛-in. choke, T.D. 6,791 ft.
Stratton field: Southern Minerals Corp. 4 Stratton, 129 bbl., 7/64-in. choke, perf. casing 6,408-16 ft., T.D. 6,745 ft.

Refugio County

Tomoconnor field: Quintana 43 Heard, 672 bbl., ¼-in. choke, perf. casing 5,843-51 ft., T.D. 5,925 ft.

Victoria County

Bloomington field: Texas Gulf Prod. Co. 1 Rogers, 15 bbl. distillate, ¼-in. choke, perf. casing 5,117-20 ft., T.D. 5,199 ft.
Keeran field: Gulf 19 Keeran, 8 bbl., 18 hr., ⅛-in. choke, perf. casing 6,076-80 ft., T.D. 10,043 ft.

LAREDO DISTRICT

Brooks County

Kelsey field: Humble 75 McGill, 48 bbl., 9/64-in. choke, T.D. 4,732 ft.

Duval County

Bridwell field: Bridwell 3 Parr, 122 bbl., 7/64-in. choke, perf. casing 4,306-09 ft., T.D. 4,348 ft.
Casa Blanca field: Magnolia 4 Duval County Ranch Co., dry, T.D. 1,813 ft.
Cedro Hill field: Magnolia 5 Duval County Ranch Co., 35 bbl., 7/64-in. choke, sand 1,427-32 ft., T.D.
Hoffman field: Cuellar Brothers 2-C Cuellar, 70 bbl., perf. casing 2,591-2,607 ft., T.D. 2,664 ft.
Lundell field: Magnolia 15 Duval County Ranch Co., dry, T.D. 1,157 ft.
Wildcat: Gilcrease 1 Weil, dry, T.D. 2,940 ft.

Jim Hogg County

Colorado field: Humble 20 King, 178 bbl., 7/64-in. choke, T.D. 3,011 ft.
Sun 11 Thaxton, 180 bbl., 7/64-in. choke, sand 2,995-3,009 ft., T.D.
Gutierrez field. Texas 2 Armstrong, dry, T.D. 3,731 ft.
Manila field: Navarro 5 Allen, 74 bbl., ¼-in. choke, sand 2,641-49 ft., T.D.

Starr County

Rincon field: W. R. Davis 29-B Slick, 102 bbl., 7/64-in. choke, perf. casing 3,808-18 ft., T.D. 4,300 ft.
W. R. Davis 35-B Slick, 102 bbl., 7/64-in. choke, perf. casing 3,808-18 ft., T.D. 4,430 ft.

Zapata County

Glen field: Jay Simmons 3 Yeager-Stroman, 200 bbl., pumping, sand 2,166-86 ft., T.D.
Jay Simmons 5 Yeager-Stroman, 100 bbl., pumping, sand 2,193-97 ft., T.D.

SAN ANTONIO DISTRICT

Bastrop County

North Dale field: Marts & Beaven 1 Harris, 15 bbl., pumping, lime 2,150-74 ft., T.D.

Bexar County

Gas Ridge field: Southwest Drilling Co. 6 Covell, 1½ bbl., pumping, sand 416-18 ft., T.D. 425 ft.

Frio County

Pearsall field: Texas Atlas Pet. Corp. 3 Cory & McWilliams, 132 bbl., pumping, T.D. 5,646 ft.

Guadalupe County

Darst Creek field: Cities Service 9 Dowdy, 47 bbl. oil and 3 per cent sulfur water, T.D. 2,630 ft.
Elm Creek field: Maston Altgelt 1 Littlejohn, dry, T.D. 1,380 ft.

By
R. MARNE SANFORD

Ordovician Well Is Gaged and New Field Opened in Pecos

MIDLAND, Tex., Nov. 11.—First actual production gages were reported at the close of the week for the deep Ordovician strike of 2 weeks ago in north Pecos County. Also to open a new shallow field just north of the Apco field in Pecos County, a previously projected Ordovician wildcat is preparing for completion at the estimated rate of 25 to 30 bbl. daily.

The deep strike, Taubert-McKee-Siemoneit 1 V. W. Crockett, Section 4½, Block 3, H.&T.C. Survey, in the Imperial area of north Pecos County, was opened for two short flows at the close of the week. At 10:37 a.m. Friday morning the well was opened and flowed 36 bbl. of oil into tanks in 18 minutes. Flow was through ½-in. tubing choke, however, the choke sanded up and the flow was cut short. Again at 11:40 it was opened and flowed through ¼-in. choke a total of 25 bbl. in 1 hour. Pressures during the last flow were 1,010 lb. on casing and 990 lb. on tubing at the start and 1,045 lb. on casing and 925 lb. on tubing at the finish. The official potential is expected to be taken early the coming week.

It was reported that the field would be named the Abel field in honor of George T. Abel, Midland, president of the Tex-Mex Petroleum Co. and a pioneer in the deep area.

A shallow field discovery was registered just north of the Ellenburger lime producing Apco field of Pecos County. It was R. G. Pattillo 1 P. E. O'Neil, Section 74, Block 10, H.&G.N. Survey, 2 miles northwest of Apco. No. 1 O'Neil flowed an estimated 25 to 30 bbl. of oil daily, naturally, through casing, after logging oil and gas in two different zones. These were from 1,607-45 ft. and from 1,647-58 ft. The hole is bottomed at 1,675 ft. where a shot is planned for the indicated pay section. The test was originally contracted to the deep Ordovician level, however, the operator has indicated that it will be completed at its present depth, should commercial production be possible.

A shallow wildcat was staked 2 miles southwest of the Lehn field in northern Pecos County during the week. It is McKean 1 J. W. Breen, 467 ft. from the northwest and 2,173 ft. from the northeast lines of Section 52, Block 10, H.&G.N. Survey. Contract depth is 1,700 ft. and it will seek the pay section of the Lehn field.

Reeves County

The old Toyah field of Reeves County is scheduled to receive a deep 3,500-ft. Delaware lime test in the near future. C. H. Kitsos of Kermit holds about 10 sections in the area and is reported to have turned a portion of the leases, together with bottom-hole money, to J. B. Dunigan and others for the drilling of the test. The proposed location is on the A. B. Burchard land in the SW¼ Section 7, Block 58, P.S.L. Survey.

Ward County

In Ward County and 3 miles southeast of the Shipley field, Sinclair Prairie 1 Wirt Davis, Section 32, Block 4, H.&T.C. Survey, is drilling ahead below 3,810 ft. and nearing the pay level found at Gulf 5 Wristen Brothers, deep wildcat 3 miles to the north. The latter well found a good showing of oil and gas from 3,980 to 4,260 ft. after logging sulfur water just above 3,980 ft. No. 1 Wirt Davis is carrying three bailers of sulfur water hourly as it drills ahead. Meanwhile Gulf 5 Wristen Brothers, Section 18, Block 5, H.&T.C. Survey, ½ mile east of the Shipley field, was last reported waiting on cement after setting whipstock at 8,712 ft. to drill by a second unobtainable fish.

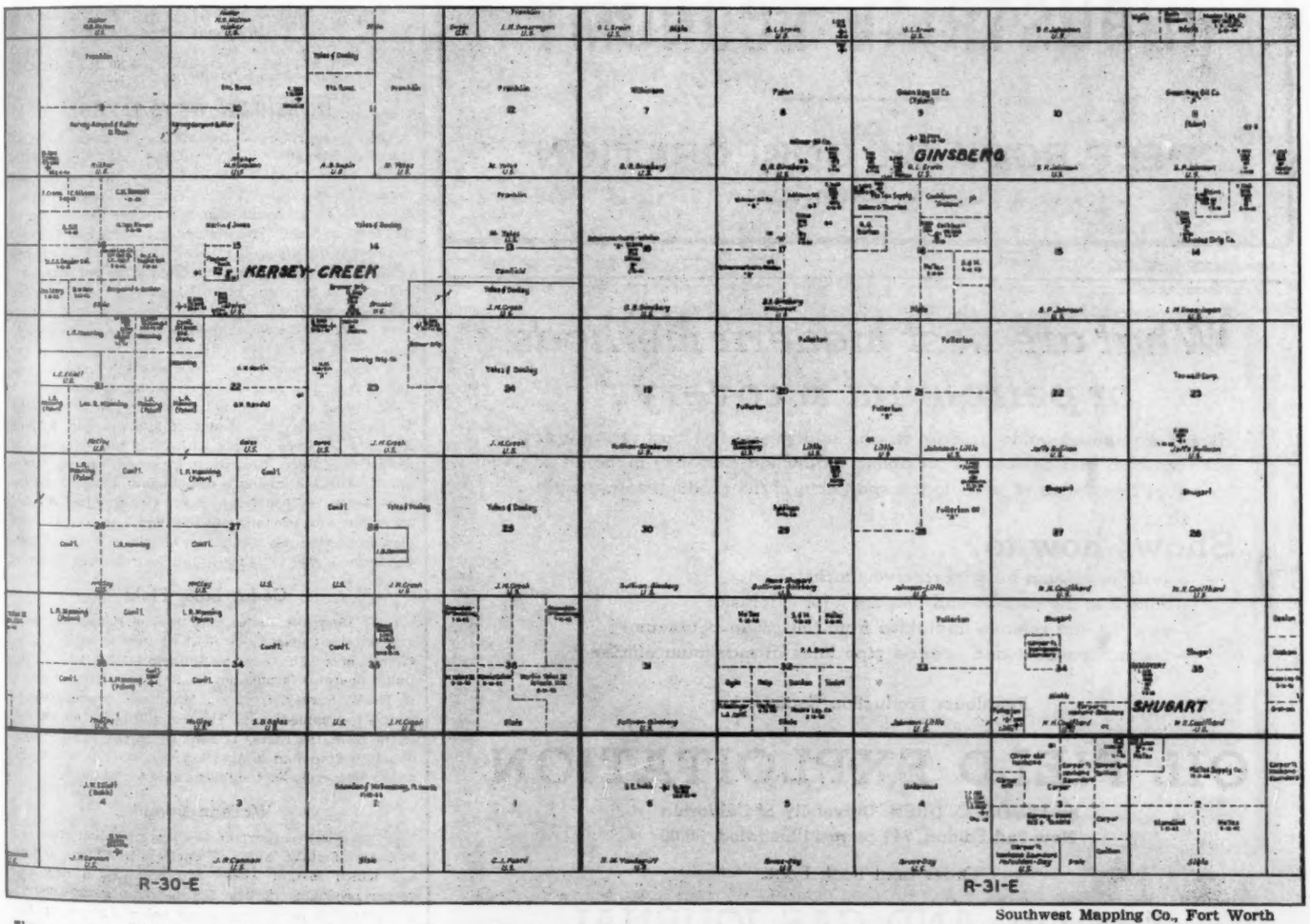
SOUTHERN WEST TEXAS COMPLETIONS

Crane County

McElroy field: Gulf 230 McElroy, 1,026 bbl., casing, 650-qt. shot, 2,749-2,940 ft.

Ector County

Jordan field: Cities Service 4-B University, 530 bbl., tubing, 490-qt. shot, 3,484-3,610 ft.
North Cowden field: M. J. Delaney 9 Smith, 1,305 bbl., tubing, 650-qt. shot, 4,130-4,430 ft.



Southwest Mapping Co., Fort Worth

Three areas in Eddy County, New Mexico, are centering considerable attention as new extension wells are added almost weekly. The Kersey-Creek field, the Ginsberg field, and the Shugart field are all recently discovered areas and are all located only a few miles southeast of the large Loco Hills field. Many pay levels are found throughout these three areas, they being 2,675 ft., 3,160 ft., 3,265 ft., 3,320 ft., 3,480 ft., and 3,600 ft. Much of the area between the three fields is proven for production. The three areas cover about 35 sq. miles

Magnolia 1 R. B. Cowden, 183 bbl., 2-in. tubing, 2,000 gal. acid, 4,240-4,400 ft.
Stanolind 5-B Midland Farms, 319 bbl., pumping, 550-qt. shot, 4,435-4,621 ft.
Johnson field: Great Western 9 Johnson, 503 bbl., tubing, 575-qt. shot, 4,107-4,310 ft.
Schermerhorn Oil 10-E Johnson, 397 bbl., tubing, 600-qt. shot, 4,065-4,197 ft.
Goldsmith field: Gulf 318 Goldsmith, 1,801 bbl., tubing, 4,000 gal. acid, 4,189-4,239 ft.
Gulf 319 Goldsmith, 1,199 bbl., tubing, 4,000 gal. acid, 4,192-4,246 ft.

Pecos County

White & Baker field: Cardinal Oil 2-E-52 White & Baker, 170 bbl., 1-in. tubing choke, 81-qt. shot, 1,727-37 ft.
H. G. Eastham 1-D University, 215 bbl., pumping, 1,000 gal. acid, 1,778-1,810 ft.
Semiwildcat: Schkade & Downs 1 Bryan-Eaton, temporarily quit 110 ft.

Ward County

Estes field: Gulf 150 O'Brien, 1,258 bbl., tubing, 430-qt. shot, 2,646-2,759 ft.
South Magnolia-Sealy field: Magnolia 1-41 Sealy, 646 bbl., 1-in. choke, natural, 2,896-2,901 ft.

Upton County

McCamey field: T. & P. Coal & Oil 12-E Lane, 166 bbl., pumping, 1,000 gal. acid, 2,327-37 ft.

SOUTHERN WEST TEXAS DRILLING REPORT

Crane County

Gulf 1-F University, SE SE Sec. 22, Blk. 31, University Sur., drilling 7,972 ft.

Crockett County

Moore & Olson 1-C Halff, NE NE NE Sec. 68, Blk. 1, I.&G.N. Sur., T.D. 500 ft., last report.

Culberson County

Cecil Cothrun 1 Casey-Rounsoville, Sec. 7, Blk. 104, P.S.L. Sur., drilling 870 ft., last report.

Ector County

Forest Development Corp. 1 Bradley, SE SE Sec. 18, Blk. 43, Twp. 3s, T.&P. Sur., drilled broken pay 4,350-4,410 ft., bailing and testing, cemented back 4,380 ft., oil coming into hole at rate of 1½ bbl. hourly, P.B. 4,362 ft., prepare to treat.

Hudspeth County

Haymon Krupp 1 Briggs, Sec. 24, Blk. 73, Twp. 7, T.&P. Sur., 5½-in. casing cemented at 6,202 ft., T.D. 6,224 ft., cementing cavings last report.

Loving County

H. C. McAuley 1 E. Hall, SE Sec. 60, Blk. 7, W.&N.W. Sur., drilling 1,025 ft.

Menard County

Harry Baldwin 1 J. A. Leggett, 760 ft. from W and 900 ft. from S lines Sec. 1, B.S.&F. Sur., 12½-in. 178 ft., drilling 550 ft.

Pecos County

Culbertson & Irwin 1 R. G. Heiner, NE NE Sec. 589, G.C.&S.F. Sur., Ordovician wildcat, set 13-in. at 520 ft.
S. D. Pattillo 1 O'Neil, Sec. 74, Blk. 10, H.&G.N. Sur., Ordovician test, est. 25 to 30 bbl. daily from 1,607-58 ft., prepare to complete.
S. D. Pattillo 1 Hoffman, SE NW Sec. 6, Blk. 141, T.&St.L. Sur., 2,000-ft. test, drilling 1,700 ft.
Taubert, McKee & Siemoneit 1 Crockett, SW Sec. 4½, Blk. 3, H.&T.C. Sur., top Simpson 4,755 ft., deepened to 5,357 ft. and found new pay from 5,320 to T.D., flowed 36 bbl. in 18 minutes, then flowed 25 bbl. in 1 hr., still testing.
Cardinal 1-F White & Baker, 440 ft. from N and 3,050 ft. from E lines of Sec. 53, Blk. Z, T.C.R.R. Sur., drilling 1,500 ft.

Presidio County

Wilcox 1 Conring, Sec. 102, Blk. 4, H.&T.C. Sur., running 10¾-in. casing at 1,038 ft., S.D. 1,040 ft.
Wilcox 2 Jones-Coffield, Sec. 38, Blk. 34, H.&T.C. Sur., P.B. to 2,369 ft. from 2,399 ft., preparing to P.B. again, last report.

Reeves County

J. B. Dunigan 1 A. B. Burchard, SW¼ Sec. 7, Blk. 38, P.S.L. Sur., Delaware test, location.
Roy Johnson 1 Perkins, Sec. 18, Blk. 7-C, P.S.L. Sur., S.D. to rig up cable tools at 1,750 ft.

Sutton County

Domain 1 G. S. Allison, SW NE Sec. 91, Blk. 9, T.W.N.G. Sur., Ellenburger lime test, S.D. 1,098 ft.

Terrell County

H. H. Sides 1 Rose, Sec. 15, Blk. 148, T.&St.L. Sur., rigging up spudder.

Ward County

Fitzpatrick & Slack 1 Wilson, Sec. 145, Blk. 34, H.&T.C. Sur., 1½ mi. SE of discovery well, drilling 3,015 ft.
Gulf 4 Wristen, Sec. 13, Blk. 5, H.&T.C. Sur., scheduled Ordovician test, top Ellenburger 9,022 ft., P.B. to 8,836 ft., old T.D. 9,167 ft., twisted off drill pipe at 8,694 ft. while drilling by junk, set whipstock 8,712-33 ft., waiting on cement.
Sinclair Prairie 1 Wirt Davis, 330 ft. NW, 2,310 ft. SW lines, Sec. 32, Blk. 4, H.&T.C. Sur., drilling 3,810 ft.

Winkler County

Gulf 147 O'Brien, SE Sec. 11, Blk. F, G.&M.M.B.&A. Sur., est. 3,000,000 cu. ft. gas 2,677-80 ft., T.D. 2,720 ft., ½ bailer oil each 30 minutes, testing.

NORTHERN WEST TEXAS

The Texas Railroad Commission has officially declared the Slaughter field of Hockley and Terry counties on the same structure as the Duggan field of Cochran County. It has ordered that field rules applying to the Slaughter field should also hereinafter be applied to the Duggan field. The Slaughter rules were amended to provide for a gas-oil ratio of 2,000 cu. ft. per barrel of oil, a well allowable distribution of 50 per cent acreage and 50 per cent potential, and a yearly bottom-hole pressure check, the first to be completed by January 1, 1941. All wells in the Duggan field were ordered retested in compliance with the new field rules. The two fields were actually joined and known to be producing from a common reservoir several months ago.

As a possibility of extending the Duggan field 3 miles to the west, Ray R. Rhodes of Midland and Atlantic Refining Co. were drilling with cable tools the plug in their 1 C. S. Dean, League 89, Lipscomb County School Lands. The 7-in. casing is cemented at 4,875 ft. and the total depth is 5,030 ft. in lime. The test has checked about flat with producers in the field, however, the production possibilities will not be known until the customary large 10,000 to 13,000-gal. acid treatment is given.

Cedar Lake Field

L. C. Harrison, Dallas, has become the second operator in the Cedar Lake field of northeastern Gaines County, opened last year by Stanolind Oil & Gas Co. The Dallas operator farmed out the S½ SW Section 4, Block H, D.&W. Survey, from Stanolind, and is preparing to start a test immediately. The test will be in the SW cor. of the tract, the Emma L. King fee, and will be a north offset to Stanolind 2 American Warehouse, a 502-bbl. well which extended the field a mile to the north.

Wasson Deep

In the southern part of the large Wasson field and in Gaines County, Amon G. Carter 4-D Wasson, a deep test which several weeks ago indicated a new and deeper producing horizon for the field below 6,000 ft., is reported to be drilling ahead below 8,250 ft. It has been drilled as a "tight" operation and very little even inaccurate information is available, however, reports are that another prospective pay level has been found below 7,000 ft. As a south offset to 4-D Wasson, the

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Tulsa, Oklahoma

same operator's 5-D Wasson is testing below 6,000 ft. in the first pay indicated by the 4-D Wasson. No gages are available on the test, however, some oil is reported being bailed from the hole.

NORTHERN WEST TEXAS COMPLETIONS

Cochran County

Duggan field: Texas Co. 1-G Mallett, 121 bbl., 9 per cent water, 1-in. choke, 13,000 gal. acid, 5,020-65 ft.

Gaines County

Wasson field: Continental 7-49 Wasson, 1,259 bbl., 48/64-in. choke, 12,000 gal. acid, 4,929-5,058 ft.
Seminole field: Magnolia and Atlantic 6-221 H. & J., 345 bbl., ½-in. choke, 6,000 gal. acid, 5,206-53 ft.

Hockley County

Slaughter field: S. W. Richardson 6 Slaughter, 690 bbl., casing, 6,000 gal. acid, 4,890-4,980 ft.
Texas Co. 11 Slaughter, 711 bbl., 1-in. choke, 10,000 gal. acid, 4,955-85 ft.

Scurry County

Sharon field: F. W. Merrick 4 West Texas National Bank, 51 bbl., pumping, 840-qt. shot, 2,240-2,450 ft.

Yoakum County

Wasson field: Magnolia 21 Mahoney, 520 bbl., 45/64-in. choke, 6,000 gal. acid, 5,020-5,191 ft.
Olivia Oil 3-B Stanford, 318 bbl., 2.20 per cent water, pumping, 1,000 gal. acid, 4,952-5,250 ft.
Texas Pacific 4-Harne, 658 bbl., tubing, 10,000 gal. acid, 5,150-5,250 ft.

NORTHERN WEST TEXAS DRILLING REPORT

Andrews County

Phillips 1-120 Embar, 1,980 ft. from S and 660 ft. from E lines of Sec. 8, Blk. 44, Twp. 2n, T.&P. Sur., T.D. 1,364 ft., reaming hole.
Phillips 1 University-Drews, NW NE Sec. 32, Blk. 10, University Lands Sur., drilling 1,700 ft.
Phillips 2 Embar, NE SE Sec. 5, Blk. 44, Twp. 2n, T.&P. Sur., ¾ mile north of Embar, prepare drill below surface casing.

Cochran County

Rhodes and Atlantic 1 Dean, C NE Tract 4, Lge. 89, Lipscomb Co. School Lands, 7-in. set at 5,975 ft., T.D. 5,030 ft., prepare drill plug.

Gaines County

Fred Postello 1 Henry James, SE Sec. 368, Blk. G, C.C.S.D.&R.G.N.G. Sur., drilling 4,984 ft.
Amon G. Carter 4-D Wasson, NW SE Sec. 50, Blk. AX, P.S.L. Sur., 9,000-ft. test, logged new pay about 6,610 ft., tight well, believed drilling about 8,250 ft.

Hockley County

Cascade Pet. 1 Walker, Sec. 22, Lge. 22, McCulloch County School Lands, drilling 4,850 ft.

Terry County

Gulf 4 Mallett, Sec. 4, Blk. X, P.S.L. Sur., SW of Slaughter field, drilling 4,300 ft.
Sloan & Zook 1 Bailey, Sec. 103, Blk. 4-X, P.S.L. Sur., 4 mi. NE of Wellman, drilling water well and moving in rig.
Denver Prod. & Refg. 1 Lewis, Sec. 62, Blk. D, Gibson Sur., 3½ mi. S Wellman, location.

Yoakum County

Forest Development 1 A. C. Whisenant, SE Sec. 553, Gibson Sur., 1½ mi. N outpost to Waples-Platter area. T.D. 5,500 ft., oil lime 5,410-85 ft., 5½-in. liner set from 4,454-5,515 ft., prepare continue testing.

TEXAS PANHANDLE

AMARILLO, Tex., Nov. 11.—There were only four completions registered in the Panhandle district the past week, two gassers, a dry hole, and one oil well. New locations showed a decided increase, with 16 sites staked, 5 more than the week previous.

The failure in the area was in Cottle County, southern part of the Panhandle. It was Ramsey Petroleum 1 Lynch, Section 66, Poitevent Survey, drilled to a total depth of 5,694 ft. It was plugged back and tested salt water at both 5,523 ft. and at 4,422 ft.

PANHANDLE COMPLETIONS

Cottle County

Wildcat: Ramsey Pet. 1 Lynch, dry at 5,694 ft.

Carson County

Magnolia 91 fee (244), 537 bbl., pumping, 3,077-3,120 ft.

Moore County

Canadian River Gas 5-A Masterson, 24,800,000 cu. ft. gas, 5,000 gal. acid, 2,550-2,615 ft.
Shamrock Oil & Gas 19 Sneed, 20,000,000 cu. ft. gas, 3,750 gal. acid, 2,653-2,820 ft.

DRILLING REPORT

Hansford County

I. T. I. O. 1 O'Laughlin, SE SE Sec. 2, Blk. 2, W.C.R.R. Sur., 3,000-ft. test, location.

Motley County

Humble 1 Matador, Sec. 29, Blk. J, B.S.B.&C.N.G. Sur., fishing bit 5,400 ft.

Ochiltree County

James R. Macon 1 W. R. Norris, SW SE Sec. 212, Blk. 43, H.&T.C. Sur., T.D. 6,274 ft., P.B. 4,300 ft., S.D.O., prepare P.B. to 4,000 ft. and shut off water.

Swisher County

Krupp-Flaherty 1 Keen, Sec. 120, Blk. 10-M, 6,500-ft. test, top salt 1,020 ft., S.D., casing 1,747 ft.

SOUTHEAST NEW MEXICO

HOBBS, N. M., Nov. 11.—There were nine completions listed for the two most active southeastern New Mexico counties during the past week, with three new oil wells in Eddy County and four new wells and two failures in Lea County.

One of Lea County's failures was the previously watched important wildcat being drilled by Ted Weiner and associates about 5 miles east of the Hardy field and only a mile west of the northwest Andrews County, Texas, line. It was 1 Saunders, located in the NE NE 20-21-38. Sulfur water at the rate of ½ bailer per hour was found after it was drilled in with cable tools to a total depth of 4,710 ft.

SOUTHEAST NEW MEXICO COMPLETIONS

Eddy County

Loco Hills field: Permier 4-F Beeson, SE NE SW 27-17-30, 100 bbl., tubing, 120-qt. shot, 3,209-23 ft.
Aston-Fair 3-B State, NW NW SW 32-17-30, 300 bbl., tubing, 30-qt. shot, 2,874-87 ft.
Stroup-Yates 2 Travis, NW NE SE 6-18-29, 45 bbl., 310-qt. shot, 2,640-3,157 ft.

Lea County

Arrowhead field: Gulf 1-D Leonard, NE SE NE 3-22-36, 83 bbl., ¼-in. choke, 5,000 gal. acid, 3,750-3,830 ft.
South Eunice field: Texas Pacific 21-A State Acct. 2, NE SW 7-22-36, 240 bbl., natural, tubing, 3,780-3,845 ft.
Wildcat: Ted Weiner 1 Saunders, C NE NE 20-21-38, dry at 4,710 ft., sulfur water.
Vacuum field: Great Western 2-E State, NW NW SW 25-17-35, dry at 4,623 ft., sulfur water.
Maljamar field: Barney Cockburn 24-B Baish, NE SW 28-17-32, 195 bbl. in 8½ hr., tubing, 200-qt. shot, 3,761-3,861 ft.
Barney Cockburn 26-B Baish, NE SE 28-17-32, 126 bbl., 7 hr., tubing, 200-qt. shot, 3,825-3,925 ft.

SOUTHEAST NEW MEXICO DRILLING REPORT

Chaves County

H. Steinberger 1 Headley .....NW SW 26-14s-29e
Est. 500,000 cu. ft. gas 1,826-28 ft., S.D. 2,245 ft.

Eddy County

Fulton 1 Johnson .....NW SE 22-19-27
8¼-in. at 850 ft., drilling 1,115 ft.

(Continued on Page 250)

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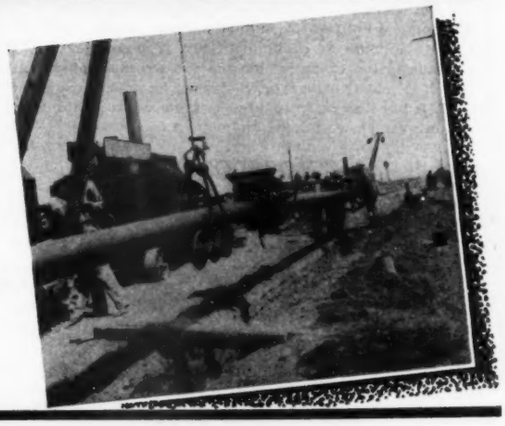

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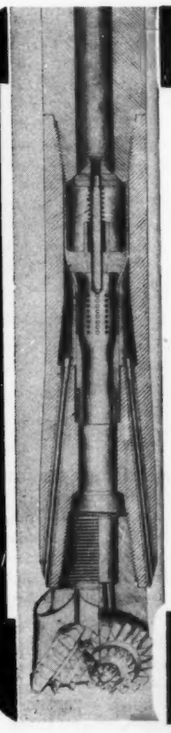

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By T. R. INGRAM

Sundance Sand Pay at Lance Creek Extended to East

DENVER, Colo., Nov. 11.—The Rocky Mountain area had nine completions of which five were oil wells, three gas wells and one dry hole.

Lance Creek had two completions in Continental 9-B Schuricht for 984 bbl. and Ohio 9 Baker-State for 315 bbl., the latter being a slight extension of Sundance sand area on the east. Ella B. Newlan 1 Howard, on south flank of La Barge field, had salt water and was abandoned at 700 ft. Cut Bank had one completion in Texas 10 Unit 9 for 200 bbl. Montana-Dakota Utilities Co. had three small gas wells in the Bowdoin field, and Kevin-Sunburst had one completion, a 25-bbl. well for Casper T. Olen 11 Engemoen.

New operations included one in Archuleta County, Colorado, five in Cut Bank and one in the Bowdoin field.

Canadian River Gas Co. and Colorado Interstate Gas Co. are boosting the capacity of the Amarillo-Denver gas line by building eight new pumping stations. Buford Oil Co. test in Rio Blanco County has reached an interesting stage with a show of oil. Sinclair-Wyoming 3 Mahoney, deep test in Mahoney dome, made 838 bbl. in 15½ hours on preliminary test. The secretary of the interior has called for bids on Salt Creek royalty oil for 1941 and Canadian interests may be among the bidders. A bill may be introduced in Congress to settle litigation over placer mining claims in Lance Creek.

COLORADO

Archuleta County

Kendrick Dev. Co. 1 fee ..... SE NE SW 36-35n-2w
T.D. 865 ft., fishing for bit. First report.
California-Colorado Oil 2 Mzcht, NE SW NW 32-36n-1w
Drilling 810 ft. in shale.

Fremont County

U-Tex Oil 1 Hassler ..... NE 28-20s-69w
T.D. 2,185 ft., ran 6⅝-in. casing, preparing to test, est. at 20 bbl. a day.

Garfield County

Joe T. Juhan 1 Clough ..... C NW SE 22-6s-94w
Drilling 506 ft. in Wasatch.

Huerfano County

R. L. Jewett 1 Valdez ..... SE NE 30-28s-67w
S.D. 212 ft.

La Plata County

Nick Spatter 1-X Bryce ..... SW SW 31-33n-9w
Drilling below 4,400 ft. in brown and gray sandy shale.

Larimer County

E. P. Gallup 1 Hanson ..... C SE NW 36-10n-71w
Drilling below 100 ft. and carrying the 12½-in.

Logan County

West Plains 1 Sheldon ..... SE NW SW 3-10n-55w
Drilling 3,190 ft. in sandy shale and lime, carrying 8¼-in. at 3,180 ft.

Moffat County

Steamboat Springs Synd. 1 Sutton, NE NE SW 1-5n-89w
S.D. 2,335 ft. in sand, to run pipe.
Mountain Fuel Supply 6-B Wilson, NE SE 14-12n-100w
T.D. 4,007 ft., P.B. to 3,550 ft. and perf. 7-in. to test upper sands.

Park County

South Park Oil 1 Lamar ..... NE NE SE 34-11s-75w
S.D. 7,496 ft. for rig repairs.

Rio Blanco County

Buford Oil Co. 1 Government, Yellow Jacket-Buford structure, is bottomed in dolomite at 4,360 ft. and showed saturation in that formation at 4,334-60 ft. through a hole full of water. No estimate can be made at this time as to the significance of the showing, but the 6⅝-in., which is being carried, will be underreamed a few feet in search of a suitable casing point when the pipe will be set, hole dried up and a test made. C. E. Shoenfelt, geologist for the company, says the formation correlates to some extent with the horizon just above the Bell sand in Lance Creek and that the hole is still bottomed in the lower Pennsylvanian. The test is one of the most important in Colorado as a discovery here will lead to testing of the deeper horizons in the southern Moffat County pools.

Texas-California 5 Unit ..... NW NE NE 34-3n-94w
Location.
Raven O. & R. 31 Government, SW NW NE 32-2n-102w
Drilling 710 ft., 8¼-in. set at 34 ft.
Buford Oil 1 Government ..... SW SW 16-1n-91w
T.D. 4,360 ft., prep. to dry up hole and test show oil at 4,334-60 ft.
Texas-California 4 Unit ..... NW NW NW 2-2n-94w
T.D. 6,698 ft., P.B. to 6,604 ft., testing.

Routt County

Craig & Moore 1-X Irwin ..... C SW NE 33-7n-85w
Resumed at 2,410 ft., and drilling in red beds at 2,463 ft., Trull Creek district.

WYOMING

Big Horn County

Prescott & Mileski 1 Govt. ..... NE NW SW 1-51n-93w
Drilling at 1,427 ft. in Thermopolis shale, 7-in. cave string set at 1,356 ft.

Carbon County

Sinclair-Wyoming 3 Mahoney, C SE NW 34-26n-88w, Mahoney dome, completed in the fall of 1938 in the Tensleep at 4,295-4,486 ft. for 172 bbl. a day natural, is showing for a good well in the lower Tensleep to which it was deepened as a test. It is bottomed at 4,505 ft. and was shot with 500 qt. at 4,363-4,505 ft., and after cleaning out swabbed 838 bbl. in 15½ hours. It is still testing.

Sinclair-Wyoming 16-A Wertz ..... SW SW SW 6-26n-89w
Drilling 2,729 ft.
Ohio 2 Lundy ..... SE NE NW 34-20n-78w
Drilling 1,280 ft.
Sinclair-Wyoming 15-A Wertz ..... SW SW NE 7-26n-89w
Drilling 1,560 ft.

Crook County

Vickers-Continental 1 Duncan-Lobban ..... NE NW SW 28-57n-64w
T.D. 1,907 ft., set 10-in. on bottom.

Hot Springs County

A. L. and Fred Freudenthal No. 1 SE NE NW 31-43n-92w
Drilling 300 ft. in Thermopolis shale, 10-in. cemented at 97 ft., Blue Springs district.

Lincoln County

Ella B. Newlan 1 Howard, 18-25n-113w, test on south flank of La Barge field, ran into salt water sand at 700 ft. and has been plugged and abandoned.

Klumpe Synd. 1 ..... SE SE SE 4-26n-113w
Drilling below 250 ft.
Superior Oil Co. 4-C ..... NE cor. Lot 3, 3-26n-113w
T.D. 850 ft., testing, old well deepened from 850 ft.
Woolf Pet. Co. No. 8 ..... SE cor. Lot 4, 3-26n-113w
T.D. 900 ft., testing, old well drilled deeper from 840 ft.

Natrona County

The secretary of the interior has called for bids on Salt Creek royalty oil from sands from the surface to and including the Sundance to be received November 15 for the calendar year of 1941 or for 3 years or 5 years. The call coming earlier than usual has caused some speculation in connection with recent unconfirmed reports that Canadian interests are seeking to purchase the Government's oil from the field for export to that country. Sinclair-Wyoming Oil Co. had the 1940 contract on the basis of 1 cent above the field posted price or Mid-Continent posted price for oil of equal gravity. The Government's royalty on light oil in 1939 amounted to 627,000 bbl.

General Pet. 37-22-P ..... NW SE SW 22-35n-77w
Rigging up rotary.
Royal Oil Corp. 1 Midert ..... SW SW SW 26-35n-80w
T.D. 1,555 ft., underreaming 8-in.
General Petroleum 57-16-S ..... NW SW SE 16-35n-77w
T.D. 4,570 ft., rigging up for pump test.

Niobrara County

Lance Creek had two completions, both of special interest.

Continental Oil 9-B Schuricht, NW SW SE 6-35n-65w, near the western edge of the field, was given a rating of 984 bbl. in 24 hours at 5,335 ft., total depth, from the Leo, top at 5,180 ft. This well was completed a year ago at 5,202 ft., as a small producer. Last month deepening operations were started and the hole was carried to 5,335 ft. It tested only 106 bbl. through a ¾-in. choke on the tubing, but after acidizing and working over it was boosted to 984 bbl.

The other completion was Ohio 9 Baker-State, NW SW NW 36-36n-65w, an outpost well on the east side of the field in the Sundance sand. It was drilled to 4,468 ft., and had the basal Sundance at 4,420-68 ft. It made 315 bbl. of oil and 30 bbl. of water on official test. It extends the Sundance pool about ¼ mile.

A near completion is Continental 20 Tom Bell, NW SE SE 33-36n-65w, which is proving somewhat of a surprise. It had the top of the Leo at 5,320 ft. and at 5,350 ft. it swabbed only 9 bbl. in 24 hours. Acidizing did not help to any extent and it was decided to drill on deeper in the hope of picking up more saturation. At 5,490 ft. it was acidized twice with 1,000 gal. each time. While swabbing it began to flow and looks like a good well. It has not been gaged and is now testing.

Continental has four operations under way on the Tom Bell Cattle tract and the logs are being carefully studied by the geologists to ascertain subsurface geology in an area that has reflected some nonconformity in former completions. It now begins to look as if there is a faulted area in that part of the field and the operations now under way are expected to reveal the facts. There were no new locations in Lance Creek and none are expected until after the first of the year.

Continental 21 Tom Bell ..... NW SW NE 33-36n-65w
T.D. 5,305 ft., cemented 7-in. at 5,286 ft., cored saturation at 5,290-5,305 ft.
Continental 22 Tom Bell ..... SE NW NW 34-36n-65w
Rig, waiting on equipment.
Continental 23 Tom Bell ..... SE NW SW 34-36n-65w
Drilling 1,643 ft., cemented 13-in. at 315 ft.
Ohio 18 Lamb-Acct. 2 ..... SE SW NE 5-35n-65w
Drilling 2,640 ft., cemented 11¾-in. at 308 ft.
Argo 9 Ford ..... SE SW NE 33-36n-65w
T.D. 5,560 ft., testing.
Continental 20 Tom Bell ..... NW SE SE 33-36n-65w
T.D. 5,490 ft., testing.
Argo 3 Elliott ..... C NE NE 6-35n-65w
T.D. 5,316 ft., cemented 5½-in. at 5,313 ft., will perf. and test.
Ohio 8 Rohlff ..... NW SW NE 32-36n-65w
Drilling 5,280 ft.

Park County

Continental 2 Northern Pacific NE NW NW 23-58n-98w
Moving in material.
Continental 4 Northern Pacific-1 SE NE SE 23-58n-98w
T.D. 3,150 ft., waiting on pump test.
Resolute 2 State ..... SW SW 16-57n-101w
T.D. 10,121 ft., P.B. to 7,400 ft., and set whipstock.

Sublette County

North La Barge Oil 5 Govt. SE NE NE 28-27n-113w
T.D. 1,070 ft., cemented 8⅝-in.
Marvel Oil Co. 5 Government ..... SE 28-27n-113w
T.D. 1,045 ft., cemented 7-in. at 1,042 ft.
Texas 1-I Government ..... SW NW SW 27-27n-113w
Drilling 400 ft.

Sweetwater County

Gus Pongratz et al 1 Clark ..... NW NE 22-19n-104w
S.D. 5,005 ft., moving in heavier equipment, top red beds 4,955 ft.
Red Desert Corp. 1 Aspden NW SW NW 34-18n-103w
Coring 5,656 ft. in top Embar.
Vermilion Oil 2 Government SW SW SW 7-12n-99w
T.D. 3,535 ft., reaming to lower 8⅝-in. to bottom.
Sinclair-Wyoming 77-A ..... SE NE NE 10-26n-90w
T.D. 4,285 ft., made 953 bbl. in 24 hr., of which 16 hr. were on gas lift, in preliminary test.

Weston County

W. H. Connor 1 State ..... NW SW NE 36-42n-61w
T.D. 982 ft., top Sundance 951 ft., 36 ft. oil in hole, will shoot and test.

MONTANA

Montana production, all fields, in September was 556,892 bbl., a decrease of 30,239 bbl. as compared with August, as reported by the state Oil Conservation Board. Storage at the end of the month was 1,097,895 bbl., a decrease of 165,719 bbl. Exports to Canada were 132,662 bbl., a decrease of 11,147 bbl. as compared with August.

Big Horn County

Massey Oil & Gas 1 Government ..... SE SW SE 11-2s-31e
T.D. 1,900 ft. in Dakota sand, rigging up cable tools, slight show water in sand at 1,895-1,900 ft.

Blaine County

Cherry Ridge Synd. 1 Harbolt ..... NW NW SW 1-35n-20e
Landed 10-in. at 1,220 ft. for formation shutoff.

Carbon County

Continental 1 Prigge, SE SE SE 33-9s-25e, Frannie field, was listed as a completion at 3,561½ ft. in the Embar-Tensleep with an initial production of 124 bbl. in 24 hours on the pump. This is the first well in the Frannie field completed on the Montana side and it is located 2,000 ft. to the northwest of the nearest pro-

(Continued on Page 250)

Fort Worth Basin Play Pushed South to Suburbs of City

By R. MARNE SANFORD

WICHITA FALLS, Tex., Nov. 11.—Two new deep-lime wildcat tests have been staked in the southern part of the Fort Worth basin. This extends the actual drilling to within only 5 miles of the city of Fort Worth.

About 3 weeks ago Bruce Sullivan, Fort Worth, announced tentative location for a 6,500-ft. test just 5 miles north of the city. During the past week rig was being moved in for actual drilling early the coming week. To extend the play even south of Fort Worth, a 5,000-ft. wildcat has been announced for northern Hood County, some 40 miles southwest of the city.

Bruce Sullivan's wildcat north of the city is 1 W. C. Putnam, on a 200-acre tract in the Milley Gilbert Survey and on an 8,000-acre block out of which spreads have been taken by Stanolind, Magnolia, Sinclair, Texas Pacific, Seaboard, and the independent firm of Hill & Hill, Inc. Various geophysical methods of exploration worked prior to the staking of the location place it on a definite high. E. Carlisle Norwood, Wichita Falls, who has the drilling contract, has finished a test higher up in the Fort Worth basin and was moving in that rig as the week closed.

Hood County Test

Southwest of Fort Worth and in the extreme northwestern corner of Hood County W. G. Martin, Dallas, has staked a 5,000-ft. wildcat on the F. W. Thormann land, F. F. Anderson Survey. The drill-site is in the east corner of a 128-acre tract in the 2,956-acre Thornmann ranch. It has already been spudded and plans call for a test of the Marble Falls or 5,000 ft., however, it was indicated possibly an Ordovician test would result. The location is about 3 miles southeast of a test drilled in 1918 by Sinclair which went to 4,810 ft. and was credited with several shows. In 1931 A. G. McLarren drilled a test southwest of the present location and found showings of gas at about 2,500 ft.

Montague and Wise Counties

The field discovery closest to Fort Worth is the recent Hults-Owen strike in southwestern Montague County some 50 miles to the northwest, and two long-testing wildcats are still attempting commercial completion in the area between that field and the city. In extreme southwestern Montague County Walter Gant 1 Laird, R. T. Millard Survey, 6½ miles west of Sunset, was recently plugged back to 6,591 ft. and during the week swabbed dry to bottom of hole, casing having been perforated from 5,775-90 ft. The operator was preparing to plug back further for another test. Several prospective zones of production were found in drilling through the Strawn, the section now being tested.

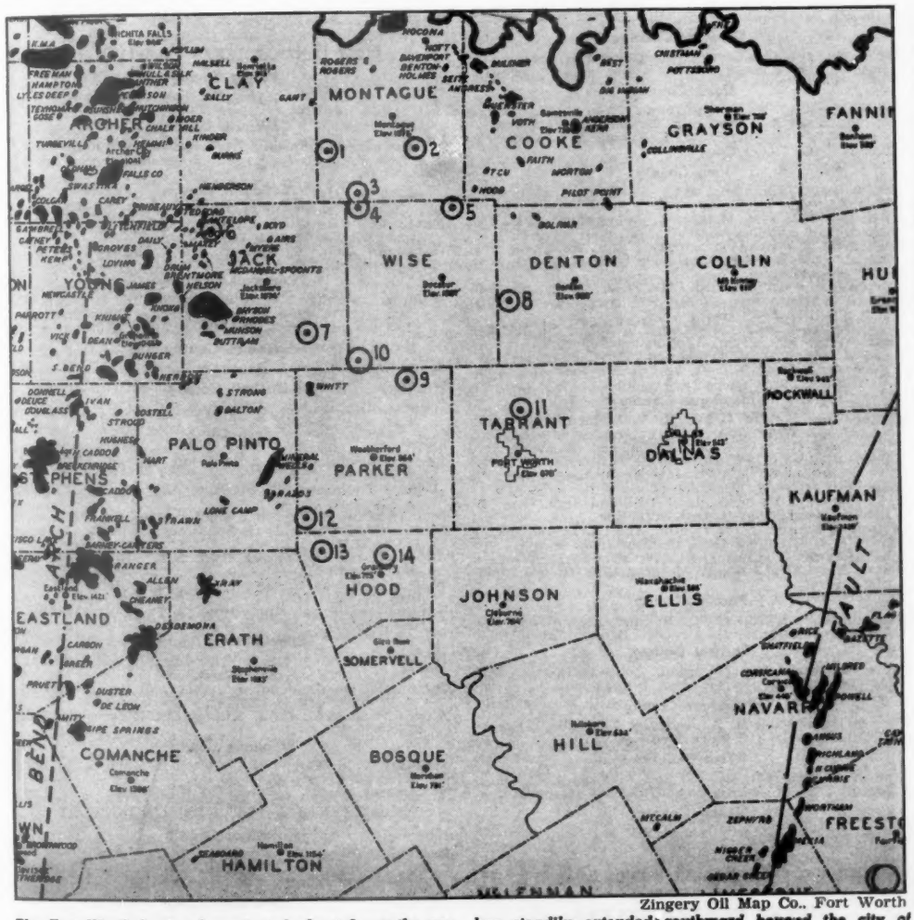
About 3 miles southeast of the 1 Laird, Cranfill and Rogers are again attempting completion at their 1 McKay, deep test in Section 8, Falls County School Lands Survey, about 2 miles west of Park Springs and in Wise County. Plug has been drilled from casing at 5,795 ft. and hole is now bottomed at 5,864 ft. Shows of oil in the conglomerate from 5,813 to 5,850 ft. will be tested. The top of the Caddo lime has been picked at 5,580 ft. Work has been delayed on this test due to a side-tracking job which resulted when tools were lost in the hole several weeks ago.

Spudding is scheduled early the coming week for the recently staked location in northeastern Wise County. It is Manahan Oil 1 E. R. Collier, center of the J. M. Wade Survey. Contract depth is 6,000 ft.

New Wildcats in Archer

A new 5,000-ft. wildcat has been located in eastern Archer County by W. B. Omohundro, Wichita Falls. It is 1 William Coleman, 467 ft. from the north and west lines of Block 52, L. Pennington Survey, one mile north of the town of Scotland. The test is on a recently acquired block of acreage and is located 4½ miles east and slightly south of the new Caddo lime field discovered about 2 months ago by Shell Oil Co., Inc. on the Coleman lands.

As a ¾-mile northwest outpost to the Coleman field, Southern Petroleum Exploration, Inc., has staked its 1 Coleman. It will be a 5,100-ft. test located 330 ft. from the north line of Lot 4, and 330 ft. west of the railroad, Block 73, A.T.N.C.L. Survey.



Zingery Oil Map Co., Fort Worth

The Fort Worth basin play, started about 9 months ago, has steadily extended southward beyond the city of Fort Worth. A few of the more important wildcats in the southern part of the basin are listed, the numbers corresponding to those on the map. (1) Owen-Hults 1 Tucker, a new field discovery. (2) Hammond 1 Jester, deep active wildcat. (3) Walter Gant 1 Laird, indicated field opener, still testing. (4) Cranfill & Rogers 1 McKay, indicated field opener, testing. (5) Manahan Oil 1 Collier, Wade Survey, new active test. (6) Conkling 1 Hoofle, 3,500-ft. test, shut down at 3,410 ft. (7) Rathke Oil 1 Mosely, possible 4,500-ft. discovery. (8) Amon G. Carter 1 Allen, deep test, drilling below 4,800 ft. (9) Leidecker 1 Keeling, deep wildcat, not yet started. (10) Montex Oil 1 Berry, new deep location. (11) Bruce Sullivan 1 Putnam, 6,500-ft. location, just north of Fort Worth. (12) Higginbotham 1 Gilbert, long active test, fishing at 4,800 ft. (13) W. G. Martin 1 Thormann, new 5,000-ft. location. (14) Aztec Oil 1 Gallagher, 3,000-ft. test, shut down at 1,180 ft.

NORTH TEXAS COMPLETIONS

Archer County

Hull-Silk field: Cox & Hamon 4 Nichols, 640 bbl., 4,361-4,425 ft.
Helmerich & Payne 4 Moss, 1,080 bbl., 4,305-26 ft.
Petroleum Prod. 2 Anderson "C", 1,019 bbl., 4,369-4,425 ft.
Anarene field: Craig & Wilson 1 Abercrombie, dry at 1,426 ft.
Vogtsberger field: Gant 1 Vogtsberger, 795 bbl., 4,644-4,725 ft.

Clay County

Thornberry field: Akin 2 Glasgow, 30 bbl., 1,255-58 ft.
Fox 1 Dunn, dry at 1,803 ft.
Gorman 2 Taylor, dry at 315 ft.
Johnson 1 Taylor, dry at 1,355 ft.
Sussex Oil 15 Glasgow, 30 bbl., 1,057-73 ft.
Sussex Oil 16 Glasgow, 40 bbl., 1,059-76 ft.
Wildcat: Horton & Wiggins and Phillips 1 Howard, Blk. 31, T. J. Belcher Sur., 133 bbl., pumping, 5,460-88 ft.

Cooke County

T. C. U. field: Dickson Oil 6 Lynn, 156 bbl., 1,085-1,198 ft.
Dickson Oil 7 Lynn, 140 bbl., 1,085-96 ft.
Dickson Oil 17 Lynn, 148 bbl., 1,064-72 ft.
Dodson & Powell 1 Rosson, 45 bbl., 1,098-1,107 ft.
Dodson & Powell 2 Rosson, 48 bbl., 1,056-68 ft.
Voth field: Humble 7 Hellman, 375 bbl., 1,280-1,302 ft.
Walnut Bend field: Magnolia 9 Ramsey, 649 bbl., 4,654-90 ft.
Muenster field: Texas 2 Johnson, dry at 1,215 ft.
Texas 23 Truebenbach, 4 bbl., 785-805 ft.
Trumpter Oil 6 Stacey, 32 bbl., 740-750 ft.

Wichita County

Burkburnett field: Chambers Simmons 1 Chenault, dry at 3,312 ft.
Gutzler 7 Jennie, dry at 282 ft.
Underwood Oil 1 Cooper, dry at 1,352 ft.
Electra field: Hammon 3 Womack, 8 bbl., 1,343-54 ft.
K.M.A. field: Hammon, Hanlon & Buchanan 31 Fassett-Tuttle, 588 bbl., 3,807-76 ft.
Maro Oil 2 Barton, 904 bbl., 3,736-3,870 ft.
F. W. Merrick 7 Jones, 537 bbl., 4,020-85 ft.
Shell 12 Griffin, 624 bbl., 3,740-3,805 ft.
Sunray Oil 2 Denny, 561 bbl., 3,930-65 ft.
Tide Water 21 Ferguson, 353 bbl., 3,790-3,840 ft.

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Venmex Oil 14 State, 808 bbl., 3,675-3,804 ft.

Wilbarger County

Electra field: Golding & Cochran 8 Waggoner, 8 bbl., 1,526-64 ft.

Young County

Olney field: Bohner & Watson 12 Prideaux, 10 bbl., 538-575 ft.
Burns 1 Rogers, 76 bbl., 868-877 ft.
Burns 2 Rogers, 71 bbl., 865-880 ft.
Duvall 1 Choate, dry at 605 ft.
T. A. Jirik 4 Huebener, 10 bbl., 1,080-95 ft.
C. B. King 8 Dailey, dry at 575 ft.
B. T. Myers 2 Calvin, dry at 678 ft.
Nunnelee 1 Brashear, dry at 2,754 ft.
W. F. Palmer 11 Campbell, dry at 1,005 ft.
W. F. Palmer 1 Campbell, dry at 1,003 ft.
W. F. Palmer 1 Morgan, 50 bbl., 955-961 ft.
Watson 1 Terrell, dry at 700 ft.
Weir 1 Routen, dry at 756 ft.
Wise & Jackson 4 Cullers, 4 bbl., 586-604 ft.
Graham field: L. C. Lawler 1 Schlitter, 3,950 bbl., 3,739-64 ft.
Sewell field: H. Zweifel 2 Martin, 892 bbl., 3,945-86 ft.

NORTH TEXAS DRILLING REPORT

Archer County

Adams Oil & Gas 1 Turbeville, Lot 39, J.C.S.L. Sur., 5,000-ft. test, drilling 1,800 ft.
Walter Gant 1 Hunter, SE NW Sec. 7, Blk. 1, H.&T.C. Sur., 5,300-ft. Caddo lime test, location.
Jack Kadane 1 Griffin, SW SE Blk. 13, P.P.C.S.L. Sur., 4,500-ft. test, 1½ mi. E Griffin field, S.D. 4,522 ft.

Baylor County

Rogers & Lanfair 1 Howe, J. Lowe Sur., Abst. 572, S.D. 2,215 ft.

Clay County

E. C. Norwood 1 Shipley, Blk. 29, Madison C.S.L. Sur., deepening below 5,066 ft., drilling 5,986 ft.

Cooke County

Dick Eubank 1 Sam Seagraves, SE cor. O. M. Gray Sur., Abst. 415, near Hood, 2,200-ft. test, Ordovician, location.

Denton County

Amon G. Carter 1 W. P. and A. P. Allen, S. Westbrook Sur., drilling 4,810 ft.
Harvey Bros. 1 Knox, R. Howard Sur., Abst. 542, old T.D. 1,357 ft., show oil 1,467-93 ft., set 6⅝-in. at 1,465 ft., drilled plug, show oil and gas, testing.

Grayson County

Texas Co. 1 Hutchinson, Samuel Stewart Sur., northeast corner of county, 7,500-ft. test, drilling 3,650 ft.

Hood County

W. G. Martin 1 W. F. Thormann, E cor. of 2,956-acre ranch, F. F. Anderson Sur., 5,000-ft. test, location.
Aztec Oil 1 Gallagher, SW SE Robert Alway Sur., 3,000-ft. test, T.D. 1,180 ft.

Jack County

Continental 1 Robertson, M. J. Swan Sur., Abst. 1650. T.D. 4,920 ft., rigging up rotary.
R. A. Conkling 1 M. Hoofle, A. James Sur., Abst. 318, 3 mi. S of Antelope, 3,500-ft. test, S.D. 3,410 ft.
Rathke Oil 1 Moseley, J. Harrison Sur., Abst. 259, 6⅝-in. at 4,465 ft., show gas 4,498-4,500 ft., waiting on title trouble.
Hanlon-Buchanan 1 Smith, NW cor. Smith tract in S. H. Tilgham Sur., 8 mi. SW Jacksboro, 3,150-ft. test, drilling 2,550 ft.
K. N. Davies 1 Jones, NW cor. E½ Sec. 2555, T.E.&L. Sur., 1 mi. SE Perrin, 2,500-ft. test, derrick.
Steed & Wilson 1 M. L. Barrey, SW part of S.F.I.W. Sur., Abst. 1562, 3,200-ft. test to Bryson sand, location.

Montague County

Walter Gant 1 Will Laird, R. T. Millard Sur., Abst. 470, 7 mi. W of Sunset, 6⅝-in. casing at 6,641 ft., T.D. 6,651 ft., perf. casing 5,775-5,860 ft., swbd. dry, prep. P.B. again and reperforate casing.
Seitz, Comegys & Seitz 1 Harris, B.B.B.&C. Sur., 10 mi. S of St. Jo S.D.O. 6,939 ft.
T. F. Hunter 1 Fatheree, L. S. Gilliland Sur., 3 mi. W Illinois Bend, 6,000-ft. test, spudding.
Benson & Benson 1 Joe Benton Abel A. Lewis Sur., 2 mi. SE of Ringgold field, drilling 1,000 ft.
J. G. Hammond 1 Jester, 84-acre tract in E. Wingate Sur., Abst. 835, 2 mi. W Mallard, 6,500-ft. test, drilling 150 ft.

Parker County

Higginbotham 1 Gilbert, T.&P. Sur., Abst. 1958, T.D. 4,800 ft., fishing.

Tarrant County

Bruce Sullivan 1 W. C. Putnam, 200-acre tract in Milley Gilbert Sur., 6,500-ft. test, prep. spud.

Wilbarger County

Charles Barnes and R. A. Andrews 1 Clarida, NE Sec. 97, Blk. 14, H.&T.C. Sur., 10-in. at 75 ft.

Wise County

Cranfill & Rogers 1 McKay, Sec. 8, Falls C.S.L. Sur., 7-in. at 5,796 ft., coring pay 5,797-5,858 ft., prep. test.

Young County

Ben H. Rankin 1 Marry Logan, SW part Blk. 2, J. W. Doty Sur., 8 mi. NE Graham, 2 mi. W Nelson field, small showing oil 3,575-3,600 ft., 5½-in. 3,565 ft., drilling plug and bailed dry, drilling 3,608 ft.

WEST CENTRAL TEXAS

FORT WORTH, Tex., Nov. 11.—Jones County's new Palo Pinto lime field just 1¼ miles north of the Avoca field remained a center of attention for another week in the West Central Texas district. The southeast offset to the discovery well which was 1 Seth, located in SE SE SE Section 181, B.B.B.&C. Survey, has been gaged. It is King Oil 1 Olson, NW NW NE Section 189, B.B.B.&C. Survey. The new well made 278 bbl. daily, naturally, from the Palo Pinto lime saturation from 3,210-14 ft.

As a north offset to this completion and as an east offset to the discovery, King Oil 1 Almquist is being drilled below 1,500 ft. A south offset to the discovery, Ungren & Frazier and J. K. West 1 Carlton, has spudded and is drilling below surface casing. It is not definitely known whether the new area will be considered a north extension to the Avoca field or whether it will be a new field. There are not any condemning dry holes between the field and the new area, however, there are several failures on the extreme west edge of the Avoca field.

Between the new Seth area and the Nowles field to the northwest, drilling is scheduled to begin at L. H. Pearson 1 Carlton, a wildcat in SE SE SE Section 1, Block 5, H.&T.C. Survey. Surface casing has been set.

Eastland County

The Caddo lime Dobbs field (sometimes called South Carbon) in Eastland County and just south of the town of Carbon, discovered last year by Dobbs Oil and greatly stimulated by the recent completion of Mahaney 1 Jackson, is being given another producer. The new completion is J. O. Fox 1 J. H. Vaughn, just northeast of the Mahaney well. No. 1 Vaughn topped the Caddo lime at 2,570 ft. and penetrated 4 ft. to 2,574 ft. where 7-in. casing was cemented. It will be drilled in early the coming week. The activity in this field has greatly stimulated general work in Eastland County, there being heretofore, no major Caddo lime field in the immediate vicinity of the town of Carbon.

Brown County

A new shallow field was opened in Brown County during the week, it being the Hogan & Stewart 1 J. H. Perry. The well gaged 8 bbl. daily from a shallow sand found from 901 to 904 ft. The field discovery is located 1,500 ft. from the north and 1,000 ft. from the west lines of Section 1, Block 1, E.T.R.R. Survey.

WEST CENTRAL TEXAS COMPLETIONS

Brown County

Wildcat: Whitesides 1 Carl Dickson, J. Grant Sur. 136, dry at 1,040 ft.

Callahan County

Callahan field: Johnson 3 Hickman, dry at 500 ft.
Hatchell field: F. J. Borman 2 Jennie Harris, dry at 449 ft.

Coleman County

Overall field: Anzac Oil 20 Overall, 34 bbl., 2,299-2,302 ft.
Novice field: States Oil 5 Morris, 152 bbl., 3,565-98 ft.
Anzac Oil 2-C Morris, 203 bbl., 2,165-83 ft.
Goldsboro field: North-South Oil 2 Mathews, 50 bbl., 3,819-46 ft.

Comanche County

Wildcat: Lone Star 1 Watkins, Sec. 30, Blk. B, B.B.B.&C. Sur., top Caddo 2,532 ft., Marble Falls 2,789 ft., 943,000 cu. ft. gas, 2,851-60 ft. after 2,000 gal. acid.

Eastland County

Semiwildcat: Smart & Brooks 1 Larkin, dry at 3,165 ft.

Haskell County

Wildcat: Bradford & Robertson 1 Coody, H. Haggard Sur., dry at 3,502 ft.

Jones County

Lewis field: Falls Refg. 3 Robinson, 306 bbl., 15,000 gal. acid, 1,875-82 ft.
Sandy Ridge Oil 12 Steffins, 140 bbl., 30-qt. shot, 1,878-97 ft.
Reid field: F. E. Farrell 2 Kohler, dry at 3,952 ft.
Noodle Creek field: J. D. Sandifer 1 Wienke, 40 bbl., 2,584-87 ft.
Avoca (North Extension) field: King Oil 1 Seth, 250 bbl., 3,203-14 ft.
Wildcat: Bourban Royalty 1 Young, H. Millars Sur. 243, dry at 1,963 ft.
Semiproven: T. D. Humphreys 3 Trippiett, 298 bbl., 2,465-76 ft.

Shackelford County

Wildcat: Roark 1 Davis, SE SW Sec. 36, Blk. 12, T.&P. Sur., dry at 1,165 ft.
Cook field: Roeser-Pendleton, Inc., and Continental 38-A-85 Cook, dry at 1,402 ft.
Bluff Creek field: C. J. Kleiner 1-C Morris, 25 bbl., 1,509-20 ft.

Stephens County

Stribling field: Horwitz & Oldom 3 Maury, 180 bbl., 4,181-4,200 ft.

WEST CENTRAL TEXAS DRILLING REPORT

Callahan County

Rhodes Drilling Co. 1 N. M. George, NW Sec. 75, O.A.L. Sur., 4 mi. E Baird, 2,700-ft. test, prepare to spud, last report.

Comanche County

Campbell 1 Stark, SW part of Asa Hoxey Sur., drilling 725 ft., last report.

Concho County

Natural Resources 1 Armor, Sec. 105, T.&N.O. Sur., 5 mi. NE of Eden, prepare to resume drilling at 1,565 ft., contract depth 3,250 ft., to Ellenburger lime, C.O. to old T.D., prepare resume drilling.

Fisher County

F. A. Stephenson 1 Maberry, SE SW Sec. 56, Blk. 1, H.T.&B. Sur., 3,400-ft. test, cored 3,285-3,302 ft., recovered sand showing oil, set casing, drilled plug, 800 ft. oil in hole, 5½-in. at 3,271 ft., swabbing and flowing by heads 3,202 ft., S.D. 3,312 ft.

(Continued on Page 252)

Fishers Reef Offshore Test Is Showing Oil and Gas in Frio

By NEIL WILLIAMS

HOUSTON, Tex., Nov. 11.—Interest along the Texas Gulf Coast district centered on the Fishers Reef prospect offshore from Chambers County, in Galveston Bay, where preparations were being made to test Humble Oil & Refining 2-C-46 State. The hole is bottomed at 9,005 ft., and 7-in. casing was cemented on bottom following an electrical survey which showed favorable indications. The Frio formation was topped at 7,565 ft. and sand and shale showing oil and gas were logged at intervals from 8,712-62 ft. and at 8,925-95 ft. This prospect is located approximately 7 miles north of the Red Fish Reef prospect, and the present well is the fourth test to be drilled, being located about 1 mile north of Standard Oil Co. of Texas 1-66 State, and northwest of Humble 45-C State, both of which were drilled below 9,100 ft. The present well has checked considerably higher than these dry holes, and prospect of opening a field is encouraging.

In the Red Fish Reef area, and located about 1 mile southwest of the discovery well, Humble 3-A-246 is coring in shale below 10,163 ft. Sand showing gas was cored at 10,004-19 ft. and at 10,027-37 ft., while 5 ft. of sand showing oil and gas was recovered in a core at 10,113-23 ft. Ten feet of gas sand was recovered at 10,123-33 ft. The discovery well, Humble 1-A-247, was completed as a distillate producer in sand at 8,814-16 ft., while the company's 2-A-246 State was completed in sand at 9,441-55 ft.

In the northern part of the Ogburn field, and about 1,200 ft. west of Goldston 1 Josey, L. M. Josey 1 Josey fee is bottomed at 7,250 ft., and 5½-in. casing was cemented at 7,190 ft., preparatory to testing. Sand showing gas with a distillate odor and salty taste was cored at 6,615-70 ft., and sand showing gas was cored at intervals from 6,900-35 ft. A third sand was cored at intervals from 7,004-29 ft., of which 7 ft. was sand with an oil odor.

Dyersdale Field

Two more producers were expected to be added to the rapidly expanding Dyersdale field, Harris County, as production tests were under way. H. C. Cockburn 8 Burkitt, about 800 ft. east of production, is bottomed at 4,101 ft., and 5½-in. casing was cemented on bottom. An electrical survey showed oil sand at 4,066-80 ft., and salt-water sand at 4,081-98 ft. J. M. English 1 West, north of production, is bottomed at 4,081 ft. with 5½-in. casing cemented on bottom. Approximately 6 ft. of sand was reported cored which indicates that the well is located near the edge of the structure.

The 8,500-ft. sand in the Rowan field, Brazoria County, was defined to the west by Texas Gulf Producing Co. 1 Hiram Moore, which is drilling ahead for the 8,900-ft. gas after a drill-stem test at 8,562-71 ft., recovered 540 ft. of salt water. This is the first well in the field to miss the 8,500-ft. pay which is the discovery sand. Rowan & Nichols et al 1 Bradbury, an outpost on the southeast side of the field, reperforated casing at 8,969-74 ft., and the well is flowing at the rate of 8 bbl. of fluid per hour through a ¼-in. choke of which 5 bbl. is distillate and 3 bbl. salt water. Tubing pressure was 1,700 lb. The field was extended to the northwest by Humble Oil & Refining Co. 1 Hubbard which is flowing 176 bbl. per day through a ⅛-in. choke. Tubing pressure was 1,825 lb., and casing pressure 1,525 lb. The hole is bottomed at 8,565 ft., and the well was completed with 5½-in. casing cemented at 8,531 ft.

West Ranch Field

Magnolia 105-A West Ranch, reported the previous week as opening production from a new sand in the West Ranch field, Jackson County, is being recompleted in the same sand section after the well flowed 198 bbl. of fluid per day through a ¼-in. choke of which 75 per cent was salt water and the balance oil. Tubing pressure was 550 lb., and casing pressure 375 lb. The perforations were cemented off, and the well is being recompleted after a drill-stem test in the same section recovered 2,000 ft. of pipe-line oil and tested 95-lb. working pressure.

In the West Ranch field, Jackson County, Wellington Oil Co. 1-A L. Ranch, cored sand and shale with an oil odor at intervals in a new horizon at 5,722-37 ft., and a drill-stem testing was being made at the close of the week. The successful completion in this horizon would open the fourth sand for the field. The well is located northeast of 4 L. Ranch in Lot 160 of the La Ward subdivision.

Sugar Valley Test

In the Sugar Valley area, Matagorda County, Helmerich & Payne 1 Herman was drilled to the contract depth of 9,502 ft., and the hole has been plugged back to 7,336 ft. preparatory to sidetracking and recoring a sand and shale section which is reported to have carried favorable oil and gas showings. The well has been "tight," and details of the core record were not available. In the same area and located in the Freeman Pettus Survey, Ohio Oil Co. 1 Blackburn is drilling in sandy lime below 8,360 ft. A 15-minute drill-stem test below 8,200 ft. is reported to have recovered a slight amount of oil and gas-cut drilling mud. This area is located about 6 miles east of the Bay City field, and the area has been worked extensively with geophysical instruments.

In the Sheridan field, Colorado County, Shell Oil Co., Inc., 3 Plow Realty Co., 1,500 ft. northeast of the discovery well, is bottomed at 8,208 ft., and a drill-stem test was being made after sand with gas odor was cored at 8,193-98 ft. A previous test at 8,139-52 ft., tested 380 lb. working pressure and recovered 364 ft. of gas and oil-cut mud with a slight brackish taste.

Location for a Wilcox test was announced for Fayette County by C. C. Garvey for 1 Antoine Meyer, 3 miles northeast of Fayetteville in the James Murphy Survey.

TEXAS GULF COAST COMPLETIONS

Brazoria County

West Columbia field: Texas 17 Phillips, 136 bbl., ⅛-in. choke, top sand 5,680 ft., T.D. 5,704 ft.

Chambers County

Anahuac field: Gulf 14 Wilcox, 795 bbl., ¼-in. choke, perf. casing 7,024-33 ft., T.D. 7,044 ft.
Humble 50 Middleton, 716 bbl., ¼-in. choke, T.D. 7,227 ft.

Fort Bend County

Blue Ridge field: R. L. Prod. Co. 3 Luscher, 205 bbl., ¼-in. choke, top sand 4,022 ft., T.D. 4,051 ft.

Harris County

Humble field: Wilson 2 Holmes, 132 bbl., pumping, top sand 1,109 ft., T.D. 1,127 ft.
Tomball field: Humble 4 Schultz, 33 bbl., ¼-in. choke, top sand 5,589½ ft., T.D. 5,592 ft.

Jackson County

Lolita field: Magnolia 3 Hinshaw, 41 bbl., 7 hr., 7/64-in. choke, perf. casing 5,921-32 ft., T.D. 6,406 ft.
Magnolia 4 Hinshaw, 127 bbl., 7/64-in. choke, T.D. 5,929 ft.
Magnolia 6 Mitchell, 18 bbl., 3 hr., 7/64-in. choke, sand 5,923-27 ft., T.D. 5,929 ft.
Standard of Kansas 1 Willoughby, 151 bbl., ⅛-in. choke, perf. casing 5,926-30 ft., T.D. 5,935 ft.
West Ranch field: Magnolia 2 Stepan, 184 bbl., 8 hr., ¼-in. choke, T.D. 5,768 ft.

Jefferson County

Lovells Lake field: Humble 2 Beaumont Launch Club, 172 bbl., ⅛-in. choke, top sand 7,793 ft., T.D. 7,803 ft.
Humble 3 Turner, dry, T.D. 7,776 ft.

Liberty County

Hull field: Gulf 1 Phoenix, top sand 9,635 ft., dry, T.D. 9,669 ft.
Esperson field: General Crude 15-B Esperson, 383 bbl., ¼-in. choke, perf. casing 6,420-50 ft., T.D. 6,504 ft.

Orange County

Port Neches field: Phillips 3 Lutcher Stark, 197 bbl., ¼-in. choke, perf. casing 2,954-58 ft., T.D. 6,126 ft.

Tyler County

Joe's Lake field: Republic 45 Hurd, 240 bbl., ¼-in. choke, top sand 7,690 ft., T.D. 7,710 ft.

Wharton County

Magnet field: Humble 28 Cockburn, 227 bbl., ¼-in. choke, top sand 5,529 ft., T.D. 5,542 ft.
Withers field: F. W. Michaux, 107 bbl., ⅛-in. choke, top sand 5,505 ft., T.D. 5,531 ft.
Texas 62-B Pierce, 60 bbl., ⅛-in. choke, top sand 5,520 ft., T.D. 5,543 ft.

TEXAS GULF COAST DRILLING REPORTS

Brazoria County

Skelly 1 MacDonald, SE of Pledger field, S.D. 8,115 ft.

Colorado County

W. R. Davis 1-A L. E. Brownson, E. S. Wooley Sur., S.D. 8,941 ft.

Galveston County

Stanolind 3 Hulen, Alta Loma field, coring shale and lime 9,066 ft.
Stanolind 1 Lobit, Alta Loma field, drilling shale and lime 9,340 ft.

Jefferson County

British American Producing Co. 1-72 State, drill stem stuck, T.D. 7,451 ft.

Montgomery County

Superior 1 T. A. McWhorter, T. J. Nichols Sur., cored salt water in Cockfield sand 5,131 ft., drilling shale 5,527 ft.

San Jacinto County

McDannald Oil Co. 1 Coline Oil Co., Cold Springs area, James Rankin Sur., drilling shale 6,600 ft.

East Texas Fields

(Continued from Page 233)

Henderson County

L. A. Demer 1 E. F. Bain, 104-acre tract in John Duncan Sur., 3½ mi. N Bazzette, Woodbine test.

Hopkins County

L. A. Rankin 1 Chapman, Francis Hopkins Sur., preparing deepen from 3,934 to 6,000 ft., moving in rig.

Kaufman County

T. G. Shaw, trustee, 1 Agnes Wynne, B. S. Newman Sur., 8 mi. E Kaufman, lower Trinity test, base Massive 6,255 ft., T.D. 6,454 ft., cleaning out to 5,000 ft., conditioning hole to resume drilling, cleaned out to 3,100 ft.

Lamar County

T. M. Parmly 1 C. H. Townsend, J. S. Porter Sur., 1⅛ mi. N Chicolo, drilling 1,402 ft.

Leon County

H. W. Hawker 1 C. H. Mills, M. Copeland Sur., 2½ mi. E of Normangee, S.D. 4,365 ft. (corrected depth).

Limestone County

Farrell Drlg. and Gulf Oil 1 F. Bevill, J. H. Murray Sur., 1 mi. SW Horn Hill, Travis Peak 4,892 ft., S.D. 4,937 ft., prepare test.

McLennan County

Rush & Sanders 1 McBride, 47-acre tract in A. R. Valdez Sur., S.D. 820 ft.
E. P. Campbell 1 Stewart, S. Burton Sur., 5 mi. N Waco, S.D. 360 ft.

Red River County

J. F. Morrissey 1 Tyler, James Miro Sur., 3½ mi. SE of Bogata, 5,000-ft. test, S.D. 2,390 ft.

Wood County

Bobby Manziel 1 F. M. Morrison, James Pollock Sur., 4 mi. N Hawkins, 10-in. at 100 ft., top Woodbine sand at 4,902 ft., T.D. 4,921 ft., saturated from 4,902-20 ft., well checks 300 ft. high, 5½-in. at 4,898 ft., 15 bbl. of 28-gravity oil recovered on initial tests, P.B. 4,894 ft. and drilled out to 4,908 ft., let stand 12 hr. and salt water rose 800 ft. in hole, drilled out to 4,925 ft. and made 85 per cent water and 15 per cent oil, water believed coming from upper part of pay level, still testing.

EAST CENTRAL TEXAS COMPLETIONS

Anderson County

Long Lake field: Alex McCutchin 1 Williams, 34 bbl., 5/64-in. choke, 5,209-93 ft.

Ellis County

Wildcat: W. E. Butler 1 Simms, De La Pena Sur., 1 mi. W. Bristol, top Austin 550 ft., base Austin 1,055 ft., top Woodbine 1,505 ft., Buda 1,885 ft., Del Rio 1,938 ft., Georgetown lime 1,988 ft., base Georgetown lime 2,403 ft., top Paluxy 2,645 ft., Glen Rose 2,787 ft., anhydrite 3,331 ft., base anhydrite 3,383 ft., Travis Peak 3,770 ft., dry at 4,055 ft.

Freestone County

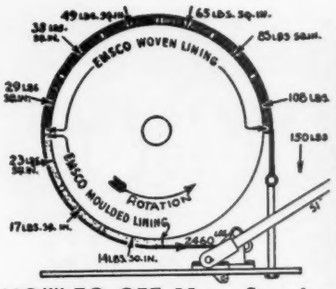
Cayuga field: Tide Water-Seaboard 2 Moody, 199 bbl., ½-in. choke, 3,936-58 ft., 4,003-06 ft., and 4,015-24 ft., casing perf.

Rusk County

Wildcat: R. T. Myers 1 Buckner, D. Warren Sur., 3 mi. NE Reklaw, top Pecan Gap 3,180-3,565 ft., Austin chalk 3,966-4,168 ft., Wocdbine sand 4,150-60 ft., Georgetown lime 4,310-16 ft., dry at 4,335 ft.

Titus County

Talco field: W. B. Hinton 2 Robertson, 60 bbl., pumping in 7 hr., tubing, 4,306-24 ft.
Humble 7 McPeters, 73 bbl., pumping, 5 hr., 4,279-89 ft.



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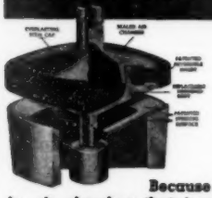

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Among the Drilling

GROOVER & ROSE, Albany, Tex., have spudded for Danciger Oil & Refineries, Fort Worth, a new test in the recently opened McElreath field in Eastland County. The test is 1 Abbott, Section 103, Block 3, H.&T.C. Survey. It is 2,000 ft. south of the discovery well which was completed from the Caddo lime at 2,963-3,035 ft. In southwestern Jones County, to the north and west, the contractors are drilling below 300 ft. at another recently started test for Danciger Oil & Refineries, Inc. It is 1 Nelson, Godwin Subdivision 82, De Witt County School Lands Survey, 3 miles northwest of the Akard field.

WALTER GANT, contractor and operator of Ardmore, Okla., together with Barney Feagin, is digging pits for a new outpost test to the recently opened Vogtsberger field in northeastern Archer County, North Texas. The test is 1 Hunter & Hancock, Section 7, Block 1, H.&T.C. Survey, a 5,300-ft. test located about a mile southeast of the field. Production in the area is obtained from a Strawn sand at about 4,680 ft. Gant will drill the well with his own rig.

W. B. OMOHUNDRO, Wichita Falls, Tex., producer and contractor, is preparing to start a wildcat test in eastern Archer County, North Texas. It will be the operator's 1 William Coleman, 467 ft. from the north and west lines of Block 52, L. Pennington Survey, about a mile north of the town of Scotland and on a block recently taken from Wayne King, of Wichita Falls. The location is about 4½ miles east and slightly south of the Coleman field, opened several weeks ago from the Caddo lime by Shell Oil Co., Inc.

SUMMITT Drilling Co. is preparing to make another completion attempt at a wildcat being drilled for Cranfill & Rogers in northwestern Wise County, North Texas. It is 1 McKay, Section 8, Falls County School Lands Survey, 2 miles west of Park Springs. Production was indicated and it was hailed as a field discovery several weeks ago. However, tools were lost in the hole and a sidetracking job resulted which has delayed proceedings until this date. The total depth is now 5,864 ft., bottomed in a new hole, and casing has been cemented at 5,796 ft.

BIG WEST Drilling Co., Dallas, Tex., is drilling the J. D. Caruthers, Tr. 1 Simmons, an important deep test in the Lisbon field of Claiborne Parish, Louisiana. The test has encountered several sands in the Travis Peak and Cotton Valley formations which show production possibilities.

CROW Drilling Co., Shreveport, La., has the contract for the J. W. Love et al 1 Eddy unit, a south edge test in Buckner, Lafayette County, Arkansas.

PENROD Drilling Co., Dallas, Tex., is drilling the H. L. Hunt 1 Pardee, a wildcat located north of the Cotton Valley field, Webster Parish, North Louisiana.

HAWKINS & HOWELL are drilling the British American Oil Producing Co. 1 Houston estate, a Sharkey County wildcat in Mississippi, where a show of oil was encountered at 3,283-84 ft.

PARKER Drilling Co., Tulsa, has the contract on a 9,000-ft. wildcat in Warren County, Mississippi, drilling for Magnolia Petroleum Co. and Exchange Oil Co.

HOUSH & THOMPSON Drilling Co., Houston, Tex., received contract from Williams and King of New Orleans for a projected 9,500-ft. test to be drilled on the Sorrento dome in Ascension Parish, coastal Louisiana. Material is being moved to the location and the well is scheduled to be spudded within the next few weeks.

W. M. McKNAB, Winfield, Kans., contractor and operator, was making hole below 3,000 ft. at Roy Starr Oil & Gas Co. 1 Minet, SW SW 15-25-17w, wildcat northeast of the McCarty pool, Edwards County, Kansas.

W. W. W. Drilling Co., Wichita, Kans., started work at Alva Billings 1 Ryan, E½ NE SE 27-8s-32w, wildcat in Thomas County, Kansas. Location is 40 miles west of a new pool just opened in Graham County and 70 miles north of the Shallow Water pool in Scott County. It is the first test to be drilled in Thomas County this year. Firm members of the W. W. W. company are Leo W. Wentworth and H. W. Williams, Wichita, and J. T. Wilson, Augusta, Kans.

PARKER Drilling Co., Houston, Tex., is nearing the expected pay horizon in the Schonner Bayou field, Vermilion Parish, Louisiana, for Union Oil Co. of California, and has started drilling operations on a projected deep test on the Au Fer pros-

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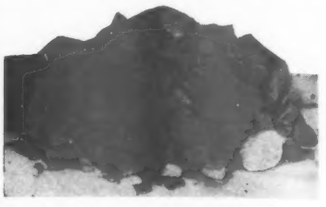

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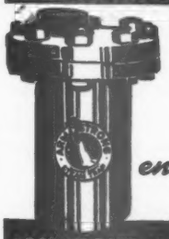

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pect in Terrebonne Parish, Louisiana, for Barnsdall Oil Co. In the Dog Lake area, Terrebonne Parish, drilling continues below 8,000 ft. in Stanolind Oil & Gas Co. 1 State.

HARBAR Drilling Co., Wichita, Kans., found a new oil pool in Graham County, western Kansas, at R. W. Shields 1 Paxon, NE cor. 11-8s-24w, which had oil in the hole at plugged-back depth of 3,860 ft. in Pennsylvanian formation. First oil was found in Lansing lime at 3,746-52 ft. It was drilled to Arbuckle lime at 3,965-4,104 ft., total depth. Nearest production is 16 miles southeastward, in the Morel pool.

FRANK DAYVAULT started drilling operations on an interesting wildcat located about 6½ miles southeast of the University field in eastern Baton Rouge Parish, coastal Louisiana. The well is being drilled for H. C. Cockburn on the Gianellon estate in 52-9s-1e.

FAIN-PORTER Drilling Co. was making hole at I. T. I. O. 1 O'Laughlin, Section 2, Block 2, W.C.R.R. Survey, eastern Hansford County, Texas Panhandle. It is on a block of 25,000 acres, extending into Ochiltree County. The block has been core drilled and seismographed. Contract is for 3,000 ft., but the hole may be carried deeper. Location is east of a gas area that may be an extension of the Hugoton gas structure through the Oklahoma Panhandle.

GEORGE ECHOLS, Houston, Tex., has apparently opened a new field just west of New Orleans, Jefferson Parish, coastal Louisiana, as his associated company, Titanic Oil Co. 1 Marrero Land & Improvement Co., blew out while drilling at 9,935 ft., and after it was brought under control showed a large volume of wet gas and some oil. In the Edwards Ranch field, drilling was started on Titanic Oil Co. 4 Edwards.

MORRIS HAMILTON Drilling Co., Houston, Tex., was preparing to test W. R. Davis Co., Inc. 1 W. F. Albrecht after the well showed promise of opening oil production in the Weser area of Goliad County, Texas. The well is bottomed at 5,381 ft., and casing was cemented for completion after a drill-stem test recovered pipeline oil.

ALLEN & MORRIS, San Antonio, Tex., opened gas and distillate production from a deeper sand in the Shield field, Nueces County, Texas, with the completion of Shield Oil Co. 1 Allen, which is flowing from perforated casing at 6,970-74 ft. In Calhoun County, Texas, the producing limits of the Duck Bay field were extended several hundred feet east with completion of Coronado Corp. 9 Welder, and the rig is expected to be moved to a new location. Four other active operations are reported in the East White Point, West Ranch, Wade City and East Flour Bluff fields for W. R. R. Oil Co., Darby Petroleum Co., T. H. McElvain, and Humble Oil & Refining Co.

T. A. CARLTON, Houston, Tex., drilling for L. M. Josey on the extreme north side of the Ogburn field, Texas Gulf Coast, is preparing to test 1 L. M. Josey fee which has promise of opening production from a new sand. Gas sand was logged in the 6,600 and 6,900-ft. sands, and 5½-in. casing was cemented at 7,190 ft., after sand with a showing of oil and gas was cored at intervals from 7,004-29 ft.

KERR-LYNN & Co., Oklahoma City, Okla., has the contract to drill a wildcat in the Navina area, Logan County, Oklahoma, a district in which several deep dry holes previously have been drilled. The new test is the I. T. I. O. 1 Cronkite, NE SE NW 22-15-4w. Contract depth is 7,000 ft. or 50 ft. in Wilcox sand.

J. W. FRAZIER, Houston, Tex., is moving a rotary to Calhoun County, Texas, for a wildcat test which will be drilled jointly with R. N. Ranger. The well is located on the F. C. Stuzenbecker lease about 5 miles north of Port Lavaca in the V. Garcia grant. In the Dyersdale field, Harris County, Texas, production tests were being made on two tests for H. C. Cockburn, both of which are expected to extend production a short distance.

HOUSTON Drilling Co., Houston, Tex., received contract from O. C. Garvey for a projected Wilcox test to be drilled in Fayette County, Texas. The well is located on the A. Meyer lease about 3 miles northeast of Fayetteville in the James Murphy Survey.

FALCON-SEABOARD Drilling Co., Houston, Tex., received contract for a 10,000-ft. test to be drilled about 6 miles southwest of Port Isabel in Cameron County, Southwest Texas, for the Pure Oil Co.

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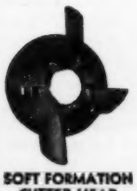

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LOUISIANA GULF COAST

By
F. L. SINGLETON

Westwego Area Test Near New Orleans Opens Field

NEW ORLEANS, La., Nov. 11.—Main interest in the Louisiana Gulf Coast district was centered on the Westwego area, 12 miles west of New Orleans, Jefferson Parish, where a new field was apparently opened by the blowout of Titanic Oil Co. 1 Marrero Land & Improvement Co. The well blew out while drilling at 9,935 ft., and after it was brought under control, a 2-in. flow line was connected on the blowout preventer, and the well flowed an estimated 8,000,000 cu. ft. of wet gas, and drilling mud with a slight show of oil. The top of the sand section was tentatively established at 9,796 ft. and excessive gas pressure was encountered after drilling past this depth. At the close of the week the company had not decided whether to test the well through the drill stem which is stuck in the hole or try to drill deeper. The well is located on a farmout lease from Shell Oil Co., Inc., in 2-13s-23e, several miles north of the prolific Lafitte field in an area which has been worked extensively with geophysical instruments.

On the South Lake Charles prospect, Calcasieu Parish, W. T. Burton and Continental 1 Mayo Realty Co., which the previous week blew out at 10,939 ft. continues to show excessive gas pressure, and the companies are having trouble in trying to recover approximately 1,100 ft. of drill stem which became stuck in the hole due to the blowout.

Superior Oil Co. 4 State, located on the Calcasieu Lake salt dome, Cameron Parish, drilled into salt at 7,867 ft., and the hole has been plugged back to 6,000 ft., preparatory to sidetracking. This is the fourth test to be drilled on the structure by the company, all of which have been failures.

Neale Field Extension

A 1½-mile west extension to the Wilcox pay in the Neale field, Beauregard Parish, was indicated as Atlantic prepared to cement casing in 1-C Rice Land & Lumber Co. after the 8,350 ft., sand was cored about normal with the other producers. The hole is bottomed at 8,420 ft. and casing will be cemented on bottom. The company's 3 Musser-Davis Lumber Co. is bottomed at 8,430 ft. and 5½-in. casing was cemented for completion.

Operators interested in the development of the newly opened deep sand in the Iowa field, Calcasieu and Jefferson Davis Parishes, are watching the progress of Glassell and Glassell 1 J. A. Bowman located on the north side of the field which is drilling below 8,443 ft., approximately 200 ft. deeper than the 8,150-8,200-ft. pay. Shell 32 Heyd, located near the center of the field, is drilling in sandy shale below 8,794 ft., with no shows reported. Magnolia 15 Wait is drilling below 8,122 ft., and should core the pay by the first of the week.

Chalkley Defined on South

The south side of the Chalkley field, Cameron Parish, was defined as Humble abandoned 5 School Board at a total depth of 9,207 ft. An electrical survey failed to reveal any showing of oil or gas. The well is located near production and the abandonment, which is due to a faulted condition, may result in the abandonment of several locations already staked in the area.

On the northwest flank of the Section 28 salt dome, St. Martin Parish, Superior 1 Stuart is drilling in shale below 9,382 ft. after a string of 7-in. casing was cemented at 9,151 ft. The casing was cemented following an electrical survey which showed favorable indications at intervals from 8,648-9,148 ft. These showings will be tested unless another sand is found.

Approximately 6 miles southeast of the University field, East Baton Rouge Parish, drilling was started on H. C. Cockburn 1 Gianelloni estate, a projected 8,500-ft. test located in 52-8s-1e.

West Cote Blanche Field

A third productive sand was opened in the West Cote Blanche field, St. Mary Parish, by Texas Co. 3 State, completed for an initial production of 535 bbl. per day through a 12/64-in. choke from perforated casing at 9,057-85 ft. The discovery well of the field which was a deep test, logged several sand sections, but the well was completed at approximately 3,000 ft., while production was recently opened at 5,000 ft.

In the same parish and located in the Charenton field, Pan American Production was preparing to test 15 Laws Realty Co. Drilled to a total depth of 10,222 ft., the well is scheduled to test a sand section between 6,700-6,900 ft., where an electrical survey showed promise of production. Development in this field during the past few months has been confined to shallow lenticular sands ranging from 1,000 to 2,200 ft. Location is in 31-13s-10e.

LOUISIANA GULF COAST COMPLETIONS

Calcasieu Parish

Iowa field: Magnolia 14 Wait, 504 bbl., 14/64-in. choke, perf. casing 8,199-8,212 ft., T.D. 8,439 ft.
Sulphur field: Union Sulphur 871 fee, 176 bbl., 11/64-in. choke, perf. casing 6,950-66 ft., T.D. 7,655 ft.

East Baton Rouge Parish

University field: William Helis 4-C Duplantier, 176 bbl., 10/64-in. choke, perf. casing 6,770-86 ft., T.D. 7,190 ft.

Iberia Parish

New Iberia field: Texas 2 Decuir, 390 bbl., 12/64-in. choke, perf. casing 6,365-75 ft., T.D. 6,470 ft.
Vermilion Bay field: Texas 4-B State, 388 bbl., 10/64-in. choke, perf. casing 10,766-10,818 ft., T.D. 10,818 ft.

La Fourche Parish

Golden Meadow field: Tippett Drilling Co. 2 Doucet, 126 bbl., ½-in. choke, perf. casing 5,435-45 ft., T.D. 5,495 ft.
Valentine field: C. & I. Drilling Co. et al 3 Dousson, 792 bbl., ¼-in. choke, perf. casing 6,946-56 ft., T.D. 6,962 ft.

Livingston Parish

Wildcat: Humble 2 Great Southern Lumber Co., dry, T.D. 9,406 ft.

St. John the Baptist Parish

La Place field: Pan American 2 Mill, 24 bbl. distillate, ½-in. choke, perf. casing 8,750-58 ft., T.D. 9,050 ft.

St. Martin Parish

Anse La Butte field: O. W. Dwyer 1 Corona, dry, T.D. 3,782 ft.
Glassell & Glassell 1 Tortoris, dry, T.D. 9,897 ft

St. Mary Parish

West Cote Blanche field: Texas 3 State, 535 bbl., 12/64-in. choke, perf. casing 9,057-85 ft., T.D. 9,103 ft.

Terrebonne Parish

Lake Pelto field: Texas 34 State, dry, T.D. 7,691 ft.

Plaquemines Parish

Stella field: California 1 Delta Minerals Unit 7, 257 bbl., ⅛-in. choke, sand 9,980-90 ft., T.D. 10,807 ft.

LOUISIANA GULF COAST DRILLING REPORT

Acadia Parish

Herton Oil Co. 1-A Leonard, 29-7s-1e, drilling shale 6,110 ft.
Humble 1 Freeland, ½ mi. SE of South Crowley production, drilling shale 8,217 ft.

Assumption Parish

Humble 1 Michie, 108-14s-15e, drilling shale 7,757 ft.

Cameron Parish

Danciger 1 Mallett Bay Land Co., E of Grand Lake field, T.D. 7,500 ft., running electrical survey.
Superior 4 State-Calcasieu Lake, T.D. 7,867 ft., salt, plugging back to sidetrack.

St. Bernard Parish

California 1 Biloxi Marsh Land Co., 25-12s-6e, moving in material.

St. Martin Parish

Superior 1 Stuart, Sec. 28 dome, drilling shale 9,382 ft.

Terrebonne Parish

Barnsdall 2 Nelson Development Co., 3-21s-11e, drilling shale 5,765 ft.
Stanolind 1 State, Bay Junop dome, drilling shale 8,105 ft.

Vermilion Parish

Union Oil 4 Louisiana Land & Fur Co., Schooner Bayou field, drilling shale 8,048 ft.
Union Oil 1-B School Board, Schooner Bayou field, drilling shale 8,046 ft.

Pacific Section of A.A.P.G. and S.E.P.M. Meet in Los Angeles

(Continued from Page 71)

brought out that Miocene production has been extensively developed in almost every field in Los Angeles Basin. The fact that the Inglewood field was one of the principal exceptions prompted the drilling of No. 1 Sentous on the south flank of the Inglewood fold by R. R. Bush Oil Co. Stanley & Stolz, incidentally, did the engineering work on this well. The Sentous test found top of the Miocene at about 7,350 ft. and productive sands were found between 8,325 and 8,757 ft. The Pliocene section was normal but thicker than expected. The upper Miocene sediments consisted principally of nodular shale, siltstone, and fine-grained silty sandstone with some altered tuff beds and volcanic material between 8,350 and 8,425 ft. Production is coming from the lower part of the upper Puente (upper Miocene).

W. S. Olson, of Texas Co., presented a paper on "Seismic Velocity Variations in the San Joaquin Valley," in which he brought out that velocity data have been obtained in about 80 wells in the San Joaquin Valley largely through the efforts of the Cooperative Well Velocity Surveying Group, organized in July 1938. Analysis of these data reveals the existence of rapid lateral changes in velocity which fit into a regional pattern. The causes of the variations were discussed and also their effect on seismic reflection mapping. Some methods for correcting reflection-survey data were outlined. About 25 slides were projected during the presentation of this paper.

Rollin Eckis, of Richfield Oil Corp., discussed the "Stevens Sand, Southern San Joaquin Valley," in a paper which received very careful consideration. Mr. Eckis brought out the fact that the Stevens sand, first penetrated in 1936 by Shell Oil Co., Inc., at Ten Section, is present beneath a large part of the southern San Joaquin Valley in Kern County. It has a maximum known thickness in excess of 2,000 ft. and at present is yielding commercial production from seven different structures. These structures are Canal, Ten Section, Greeley, Tupman, Coles Levee, Canfield Ranch, and Strand. It comprises the series of sands penetrated by wells in the southern part of the San Joaquin Valley that lies below the top of a prominent cherty brown shale zone within the upper Miocene. J. E. Eaton, a consulting geologist of Los Angeles presented by title a paper on "Ecologic Factors in Correlation." This paper is being completed and while not presented at this year's session for discussion will be published in the official bulletin of the association. At the Thursday night session of the paleontologists, Roy Barnes, of Continental Oil Co. presented a revised paper entitled Exploration Activities and Results in California.

By
STAFF CORRESPONDENT

Perry County Wildcat Being Tested in Cypress Sand

MATTOON, Ill., Nov. 11.—Activity increased in Illinois during the past week as 77 wells were completed of which 59 were producers. Activity in the major fields, however, continues to decline with only two completions in Salem good for 320 bbl. and nine in Louden, including eight producers with an initial production of 825 bbl., and one dry hole. The remaining 66 wells were scattered throughout the basin area and included 49 producers with initial production of 9,363 bbl. or 191 bbl. per well. White County was well in the lead with 18 producers. Production was below average, however, as these averaged only 120 bbl.

Trenton Tests

Another Trenton test was abandoned as H. Schwartz 1 Schlafly, SE NE SE 3-2n-3w in Clinton County, found the Trenton dry after penetrating it 96 ft. from 3,434 ft. Borton 1 Storer, SW NW NE 13-1n-1e, in the Centralia field continues to have trouble. It was reported as swabbing 12 to 15 bbl. an hour after a 3,000-gal. acid treatment and a 50-qt. shot. It was being reacidized with 5,000 gal. over the week end.

Gallatin County Wildcat

Carter 1 R. M. York has reported six pays, namely, a shallow sand in the Pennsylvanian, Biehl, Palestine, Hardinsburg, Benoist and McClosky. The well, which is located in SE SE SW 35-7s-8e, Gallatin County, was plugged back to the Palestine where it is reported as producing 148 bbl. oil and 152 bbl. fresh water. The source of the water is now being sought as it is not believed to be coming from the formation.

Testing Perry County Well

G. H. Blankenship 1 E. F. Malinsky, NW NW NE 24-4s-2w in Perry County, was drilled to the Benoist at 1,338 ft., and has been plugged back to test 9 ft. of saturation in the Cypress at 1,120-29 ft. Two other wells are under way in this area, with G. H. Blankenship 1 Bathon estate, 2 miles west of 1 Malinsky in SW SW NE 15-4s-2w, drilling at 500 ft., and Thompson 1 K. Prusacki moving in material in SW NE 15-4s-2w.

Other Wildcats

Kilpatrick & Hartshorn 1 Mason Community, on the west edge of Mason in Effingham County, in SE SE NW 22-6n-5e, flowed oil and gas on a 19-minute drill-stem test in the McClosky at 2,489 ft. This well is 15 miles from the nearest production in the St. James field and will be completed early in the week.

In Hamilton County, Kingwood 1 Williams, S½ SE NE 3-4s-6e, swabbed oil and water from the McClosky at 3,461-66 ft. The well was bottomed in the St. Louis at 3,578 ft. Latest reports show Exchange Kingwood 1 Prince, another Hamilton County wildcat shut down at 3,257 ft. in the Ste. Genevieve. Hamilton County's third important wildcat, Exchange 1 Stelle, SW NW SE 27-5s-6e, swabbed 284 bbl. oil and 5 bbl. water from Benoist at 2,945-62 ft.

ILLINOIS COMPLETIONS

Bond County

Magnolia 5 Grigg ..... SE SE NE 9-6n-2w
Pumped 75 bbl. oil and 8 bbl. water, 10-qt. shot 1,008-13 ft., Benoist 1,004 ft., T.D. 1,015 ft.
Natl. Petro. 8 Spindler ..... NE SW NW 10-6n-2w
Pumped 62 bbl. oil and 5 bbl. water, 10 and 30-qt. shots, Benoist 1,002 ft., T.D. 1,016 ft.
Shell 1 Dunnigan ..... SW NW SE 21-6n-2w
Dry, Ste. Genevieve 1,080 ft., McClosky 1,125-30 ft., St. Louis 1,172 ft.

Clay County

Pure 2 E. J. Feller ..... NW NW NE SW 5-1n-8e
Pumped and flowed 446 bbl., 5,000 gal. acid, pay 3,031-38 ft., 3,044-58 ft., Ste. Genevieve 2,978 ft., T.D. 3,100 ft.
Pure 2 Barth-Hubble Consol. ..... SE NE NE 5-1n-8e
Pumped 6 bbl. oil and 2 bbl. water, 6,000 gal. acid, pay 3,033-35 ft., 3,038-40 ft., Ste. Genevieve 2,970 ft., T.D. 3,150 ft.

Clinton County

H. Swartz et al 1 Schlafly ..... SE NE SE 3-2n-3w
Dry, Cypress sand 1,020 ft., Paint Creek 1,090 ft., Benoist 1,160 ft., Aux Vases 1,220 ft., Ste. Genevieve 1,310 ft., Salem 1,530 ft., Louisiana lime 2,450 ft., Devonian 2,514 ft., Maquoketa 3,248 ft., Trenton 3,434 ft., T.D. 3,530 ft.
Pure 1 A. L. Moseley-C ..... W½ NW NW 3-2n-8e
Pumped 81 bbl., naturally, pay 2,598-2,602 ft., 2,604-14 ft., Cypress 2,586 ft., T.D. 2,614 ft.
W. P. Ford 1 Knolhoff ..... SW SE NE SW 2-1n-2w
Pumped 20 bbl. oil and 2 bbl. water, Benoist 1,323 ft., T.D. 1,328 ft.
Arcadia Royalty 1 Monker ..... SW SW SW NW 11-1n-2w
Pumped 32 bbl., 20-qt. shot 1,173-79 ft., Glen Dean 994 ft., Cypress sand 1,172 ft., T.D. 1,189 ft.
Thompson Drlg. 1 H. Knolhoff ..... S½ NW SW 11-1n-2w
Pumped 15 bbl. oil and 7 bbl. water, 3-qt. shot 1,191-95 ft., Glen Dean 1,002 ft., Cypress sand 1,189 ft., T.D. 1,196 ft.

De Kalb County

J. E. Milburn 1 Eraas ..... NE NW SE 22-38n-3e
Dry, T.D. 520 ft.

Edwards County

Superior 1 Fewkes ..... NW NE NW 18-2s-11e
Pumped 610 bbl., 5,000 gal. acid, McClosky 3,134-40 ft., T.D. 3,204 ft.
Tuesday Oil 1 L. J. Horton ..... SE NW SE 13-2s-10e
Flowed 211 bbl., 5,000 gal. acid, perf. 3,133-43 ft., McClosky 3,133-43 ft., 3,207-23 ft., T.D. 3,228 ft.
Noah & Morrison 1 L. J. Horton NE SW SE 13-2s-10e
Flowed 433 bbl., 4,000 and 3,000 gal. acid, perf. 3,110-21 ft., 3,172-76 ft., 3,186-98 ft., McClosky 3,113-34 ft., 3,172-74 ft., 3,186-3,200 ft., T.D. 3,200 ft.

Franklin County

Benedum-Trees 1 Sheppard ..... SE NE SE 27-7s-4e
Pumped 267 bbl., 1,000 and 3,000 gal. acid, McClosky 3,144 ft., T.D. 3,153 ft.

Fayette County—Louden Field

Carter 1 Anderson ..... SE NE SW 35-9n-3e
Pumped 5 bbl. oil and 20 bbl. water, 10 and 30-qt. shots, Cypress 1,526-38 ft., T.D. 1,603 ft., P.B. to 1,538 ft.
Carter 3 J. C. Black ..... SW SW SW 16-8n-3e
Pumped 108 bbl., 20 and 30-qt. shots, Paint Creek stray 1,552-69 ft., T.D. 1,569 ft.
Carter 3 St. Pierre ..... SE NE NW 1-8n-3e
Pumped 48 bbl., 20-qt. shots 1,519-29 ft., Cypress 1,478 ft., T.D. 1,532 ft.
Carter 1 Harry Graves ..... NW SW SW 24-8n-3e
Dry, swabbed 10 gal. oil and 1 bbl. salt water an hour, 90-qt. shot 1,491-1,520 ft., Glen Dean 1,288 ft., Cypress 1,428 ft., Cypress sand 1,451-1,522 ft., T.D. 1,547 ft., P.B. to 1,522 ft.
Carter 3 Botterbusch ..... SE SE NE 30-8n-3e
Pumped 96 bbl., 10-qt. shot 1,477-81 ft., Cypress sand 1,452-83 ft., T.D. 1,483 ft.
H. P. Dunn 3 McCann ..... SE NW SE 31-8n-3e
Pumped 55 bbl. oil and 20 bbl. water, 20-qt. shot 1,502-14 ft., T.D. 1,598 ft., P.B. to 1,520 ft.
Magnolia 23 T. C. Clow ..... SW SE NW 5-7n-3e
Pumped 340 bbl., 20-qt. shot, 1,531-41 ft., Paint Creek sand 1,524 ft.
Minerva 2 F. Ball ..... SE SW SE 16-7n-3e
Pumped 101 bbl., 25-qt. shot, 1,567-77 ft., Cypress sand 1,562 ft.
Carter 15 E. McCormick ..... SW NW SE 18-7n-3e
Pumped 72 bbl., 5 and 10-qt. shots, Cypress sand 1,498-1,587 ft., Paint Creek stray 1,582-94 ft., T.D. 1,594 ft.

Gallatin County

Exchange 1 O. Evans ..... W½ NW NE 20-5n-10e
Dry, T.D. 3,042 ft.

Hamilton County

Exchange 5 Friel-B ..... SE SE NW 34-5s-6e
Pumped 40 bbl., 10-qt. shot, Benoist 2,983 ft., T.D. 2,995 ft.
W. C. McBride 2 L. O. York ..... SE SE NE 34-5s-6e
Pumped 85 bbl., 10 and 10-qt. shots, Benoist 2,939 ft., T.D. 2,957 ft.
Buell & Herndon 1 J. H. Porter ..... NW NE SE 30-6s-7e
Dry, Menard 2,274 ft., Waltersburg 2,395 ft., Tar Springs 2,447 ft., Glen Dean 2,543 ft., Golconda 2,670 ft., Cypress 2,811 ft., Cypress sand 2,840 ft., Benoist 3,040 ft., Aux Vases 3,075 ft., Ste. Genevieve 3,124 ft., McClosky 3,221-29 ft., T.D. 3,307 ft.
Cameron 2 Wilson ..... SE SW NE 6-6s-7e
Pumped 85 bbl., 40-qt. shot, Cypress sand 2,696-2,714 ft., T.D. 2,716 ft.
Texas 1 S. Edwards ..... NW NE NE 3-6s-6e
Flowed 262 bbl., naturally, Benoist 2,928 ft., T.D. 2,946 ft.

Jasper County

Continental 1 G. T. Toland ..... NE NE SW 34-7n-8e
Dry, Menard 2,260 ft., Waltersburg 2,340-46 ft., Vienna 2,372 ft., Tar Springs 2,337 and 2,445 ft., Golconda 2,545 ft., Cypress 2,638 ft., Cypress sand 2,663 ft., Paint Creek 2,770 ft., Benoist 2,839 ft., Aux Vases 2,910 ft., Ste. Genevieve 2,957 ft., McClosky 3,100-03 ft., St. Louis 3,175 ft., T.D. 3,224 ft., P.B. to 3,020 ft.
Pure 2 W. G. Murvin ..... NW NW SW 16-6n-10e
Flowed 1,310 bbl., 1-in. choke, 5,000 gal. acid, pay 2,775-80 ft., 2,783-85 ft., Fredonia 2,772 ft., T.D. 2,797 ft.
Pure 1 G. E. Adams ..... W½ NW NE 20-5n-10e
Flowed 1,126 bbl., 1-in. choke, naturally, pay 2,788-97 ft., Fredonia 2,782 ft., T.D. 2,815 ft.

Marion County—Salem Field

Texas 14 S. Parker ..... SW SE SE 28-2n-2e
Pumped 53 bbl. in 13 hr., McClosky 2,028-45 ft., T.D. 2,045 ft.
Texas 17 C. E. Richardson ..... NE NE SE 5-1n-2e
Pumped and flowed 267 bbl., 5,000 gal. acid, pay 3,467-75 ft., Devonian 3,408 ft., T.D. 3,520 ft.

Montgomery County

Ed Soloman 1 Carroll ..... NE SE NE 3-8n-5w
Dry, show oil and water 673-75 ft., T.D. 773 ft.
C. C. Taliafero & L. C. Kesler 1 A. Novak ..... SE NE NW 11-7n-4w
Dry, T.D. 1,202 ft.

Peoria County

Blue Bell Oil 1 Kyle ..... NW SW NW 17-8n-6e
Dry, Kinderhook 659 ft., Devonian 887 ft., T.D. 1,011 ft., P.B. 910 ft.

Richland County

Pure 1 M. Rose ..... W½ SE NW 7-4n-10e
Pumped and flowed 344 bbl., naturally, pay 2,906-12 ft., 2,917-20 ft., Fredonia 2,895 ft., T.D. 2,928 ft.
Pure 1 E. E. Rhinehart ..... S½ SW NW 33-4n-9e
Pumped 33 bbl., 5,000 gal. acid, Fredonia 2,968 ft., pay 2,972-85 ft., T.D. 3,005 ft.
Baldwin et al 1 Brashear ..... SW SW NW 24-4n-9e
Pumped 40 bbl., 20-qt. shot, 2,580-98 ft., Cypress sand 2,571 ft., saturation 2,580-99 ft., T.D. 2,599 ft.
Ill. Prod. 1 W. W. Spotswood ..... N½ SW SW 1-2n-10e
Dry, Aux Vases 3,204 ft., Ste. Genevieve 3,273 ft., Rosiclare 3,292 ft., Fredonia 3,325 ft., T.D. 3,398 ft.

St. Clair County

Sklar Oil 35 M. Dyroff, 200 ft. E line and 150 ft. S line Lot 39 28-1n-10w, pumped 170 bbl. oil and 4,000 bbl. water, 1,000 gal. acid, Trenton 408 ft., T.D. 442 ft.

Saline County

H. G. Spiller et al 1 Ada Sisk ... NE NE NE 15-10s-6e
Junked hole, T.D. 1,416 ft.

Shelby County

P. Doran 1 Yakey-Gallagher .... SW SE NW 33-10n-4e
Dry, Glen Dean 1,440 ft., Cypress 1,599 ft., Paint Creek 1,658 ft., Benoist 1,743 ft., Aux Vases 1,843 ft., T.D. 2,005 ft.

Wabash County

Big Chief 1 Siebert ..... NW NE SW 34-2n-13w
Pumped 40 bbl., 3,000 gal. acid, McClosky 2,664-70 ft., T.D. 2,676 ft.
Leighty et al 1 W. Trimble ..... E½ E½ E½ 35-2n-12w
Dry, T.D. 1,450 ft.
Wabash Co. Oil 1 Hahn ..... NE SW NW 8-1n-12w
Pumped 125 bbl., 60-qt. shot 1,510-42 ft., Biehl 1,510-40 ft., T.D. 1,550 ft.
R. R. Martin 1 Pixley ..... NE SE SE 7-1n-12w
Dry, T.D. 1,550 ft.
Tide Water-Seaboard 1 Ed Steckler-A ..... SW SW NW 26-1s-13w
Pumped 55 bbl., 3,000 gal. acid, pay 2,578-81 ft., Ste. Genevieve 2,550 ft., T.D. 2,595 ft.
W. W. Gray 5 fee ..... SE SW SE 14-3s-14w
Pumped 211 bbl., Cypress 2,476 ft., T.D. 2,506 ft.

Washington County

L. V. Horton 3 B. Bielatowicz .... SE SE SW 23-3s-3w
Pumped 50 bbl. oil and 10 bbl. water, 20-qt. shot, Benoist sand 1,247-59 ft., saturation 1,259-72 ft., T.D. 1,272 ft.

Wayne County

Pure 7 W. Hubble-A ..... W½ SW NE 32-2n-8e
Flowed 760 bbl., 5,000 gal. acid, pay 3,043-45 ft., Ste. Genevieve 2,987 ft., T.D. 3,112 ft.
Pure 1 Douthitt Consol. ..... W½ SW NE 29-2n-8e
Flowed 757 bbl., 5,000 gal. acid, Ste. Genevieve 2,992 ft., pay 3,046-50 ft., T.D. 3,115 ft.
Robinson et al 3 Joe Felix-A ..... NE SW SW 26-2s-8e
Pumped 139 bbl., 4,000 gal. acid, McClosky 3,343-49 ft., 3,358-70 ft., 3,388-94 ft., T.D. 3,400 ft.
D. W. Humphreys 1-C Brach ..... E½ SE NW 4-2s-7e
Pumped 46 bbl., 3,000 gal. acid, pay 3,243-53 ft., Fredonia 3,227 ft., T.D. 3,293 ft.

White County

J. R. Less et al M. Scudamore ..... N½ SW SE 29-3s-9e
Dry, Menard 2,515 ft., Glen Dean 2,790 ft., Cypress 3,015 ft., Ste. Genevieve 3,395 ft., Fredonia 3,443 ft., T.D. 3,455 ft.
J. R. Less 1 L. Pollard ..... NE SE SE 29-3s-9e
Pumped 50 bbl. oil and 8 bbl. water, 5,000 gal. acid, Ste. Genevieve 3,387 ft., pay 3,447-56 ft., 3,460-68 ft., T.D. 3,468 ft.
J. R. Less 1 Chas. Pollard ..... E½ SE NE 29-3s-9e
Pumped 8 bbl. oil and 75 bbl. water, 5,000 gal. acid, Ste. Genevieve 3,361 ft., pay 3,414-20 ft., T.D. 3,468 ft., P.B. to 3,456 ft.
Ben Nation et al 1 Painter ..... NE NE SE 19-3s-8e
Pumped 168 bbl., 20-qt. shot, Aux Vases sand 3,218-52 ft., T.D. 3,252 ft.
Cornwell et al 2-B Felix ..... E½ SE NE 19-3s-8e
Pumped 170 bbl. oil and 8 bbl. water, 30-qt. shot, Aux Vases 3,220 ft., saturation 3,228-32 ft., T.D. 3,259 ft.
Arrow Drlg. & Walker 1 F. M. Hon-B ..... SW NE SW 33-3s-14w
Pumped 228 bbl. oil and 305 bbl. water, 2,000 gal. acid, perf. 2,895-98 ft., McClosky 2,890-2,900 ft., T.D. 2,900 ft.
Superior 4 Givens ..... SE NE SE 33-4s-14w
Flowed 190 bbl. in 19 hr., 3,000 gal. acid, McClosky 2,882-86 ft., T.D. 2,895 ft.
Sun 19 Greathouse ..... NE NW SE 33-4s-14w
Flowed 147 bbl., 4,000 gal. acid, Ste. Genevieve 2,834 ft., pay 2,876-84 ft., T.D. 2,890 ft.
Superior 1 Stanley ..... SW SE NW 27-4s-14w
Dry, Menard 2,055 ft., Tar Springs 2,235-42 ft., Glen Dean 2,348 ft., Golconda 2,440 ft., Cypress sand 2,604-30 ft., Ste. Genevieve 2,844 ft., McClosky 2,916 ft., T.D. 2,957 ft.
Cherry & Kidd 2 W. W. Gray-D NW NW NE 17-4s-14w
Pumped 85 bbl., 90-qt. shot, Cypress sand 2,596 ft., Paint Creek 2,661 ft., T.D. 2,710 ft.

Burr Lambert 5 G. P. Calvin . . . SW NE SW 9-4s-14w
Pumped 135 bbl., naturally, Aux Vases 2,824-46 ft., T.D. 2,846 ft.
Cherry & Kidd 3 W. W. Gray-C . . . SW SW SE 8-4s-14w
Pumped 60 bbl., 100-qt. shot, 2,664-2,716 ft., Benoist 2,692 ft., T.D. 2,720 ft.
Cherry & Kidd 6 W. W. Gray-A . . SE SE SE 8-4s-14w
Dry, Aux Vases 2,788 ft., Ste. Genevieve 2,872 ft., Fredonia 2,908 ft., T.D. 2,976 ft.
Tide Water 1 Evans . . . . . SW NW NW 4-4s-14w
Flowed 129 bbl., 2,000 gal. acid, Ste. Genevieve 2,835 ft., pay 2,856 ft., T.D. 2,969 ft.
Magnolia 2 E. Cox . . . . . NW NW SE 27-4s-14w
Pumped 393 bbl., 3,000 gal. acid, McClosky 2,882-86 ft., T.D. 2,892 ft.
Wm. Spellisy et al 1 F. M. Hon-E SW SE SW 9-4s-14w
Pumped 192 bbl., 15-qt. shot, Aux Vases 2,828-45 ft.
Ben Nation 2 Rosa Dunn . . . . . SW NW NW 6-4s-8e
Pumped 105 bbl., 40 and 40-qt. shots, Aux Vases 3,228-55 ft., T.D. 3,390 ft.
Carter 1 C. S. Austin . . . . . NE SE NW 22-6s-9e
Pumped 3 bbl., 20-qt. shot, Waltersburg sand 2,223 ft., T.D. 2,263 ft.
Olson Drlg. 1 Rostal . . . . . E½ NW NW 26-6s-8e
Pumped 40 bbl. oil and 40 bbl. water, Benoist 2,900 ft., pay 3,105-17 ft., 3,161-83 ft., T.D. 3,184 ft.
Mercer Bros. 3 Chapman . . . . . W½ NE NW 26-6s-8e
Pumped 20 bbl., Ste. Genevieve 2,995 ft., pay 3,005-11 ft., 3,036-44 ft., 3,062-74 ft., T.D. 3,159 ft.
Penn. Ill. 4 W. Pyle . . . . . W½ NE NE 12-6s-8e
Pumped 40 bbl. oil and 100 bbl. water, Ste. Genevieve 3,032 ft., pay 3,071-75 ft., T.D. 3,137 ft.

ILLINOIS DRILLING REPORT

Bond County

J. Farrelly 1 Kyle . . . . . SW NW NW 28-4n-4w
S.D. 1,417 ft.

Bureau County

John Wall 1 F. J. Baird . . . . . NW NW NW 9-18n-10e
S.D. 1,180 ft.

Clay County

Schuman 1 L. Dehart . . . . . W½ NW SW 10-3n-7e
Menard 2,235 ft., drilling 2,249 ft.
Dee Miller 1 Smith . . . . . NE SW SW 15-3n-7e
Drilling 1,380 ft.
Big Chief Drlg. 1 Seibert . . . . . SE SW NW 34-2n-13w
Derrick.

Clinton County

Nat. Consumers Oil 1 Fricke . . . . . NW SE SW 14-1n-2w
Drilling 215 ft.

Crawford County

Nielson Bros. 1 First Nat. Bk. . . . . NW SW NW 4-8n-12w
Drilling 900 ft.

Douglas County

Pogue et al 1 Owens . . . . . NW SW NW 26-15n-7e
Drilling 100 ft.

Edwards County

J. D. Barnes 1 Hodgson . . . . . N½ NE 1-2s-10e
10-in. 50 ft., drilling 200 ft.

Fayette County

Luttrell et al 1 Ball . . . . . NE SW SE 16-7n-3e
Spud.
John Pummill 1 Isbell . . . . . NW NE SW 33-8n-1w
S.D. 1,240 ft.
Carter 1 L. Dial . . . . . SW SE NE 12-8n-32
Location.

Ford County

Nelson et al 1 Erp . . . . . SW NW SE 19-24n-7e
St. Peter 2,112 ft., drilling 2,365 ft.

Franklin County

Helmerich & Payne 1 P. M. Marvel NW NW SW 36-7s-4e
Drilling 1,851 ft.

Hamilton County

Kingwood 1 Williams . . . . . S½ SE NE 3-4s-6e
St. Genevieve 3,377 ft., St. Louis 3,566 ft., S.D. 3,578 ft., swab 150 bbl. oil and 17 bbl. water in 12 hr. Later swabbed 30 bbl. oil and 160 bbl. water in 8 hr.
Exchange-Kingwood 1 Prince . . . . NW SW NW 31-5s-7e
Menard 2,239 ft., Waltersburg 2,339 ft., Vienna 2,372 ft., Tar Springs 2,380 ft., Glen Dean 2,467 ft., Golconda 2,620 ft., Cypress 2,743 ft., Paint Creek 2,921 ft., Benoist 2,964 ft., drilling ahead.
Exchange 1 Stelle . . . . . SW NW SE 27-5s-6e
Benoist 2,945 ft., T.D. 2,962 ft., swabbed 284 bbl. oil and 5 bbl. water, testing, T.D. 2,972 ft.

Hancock County

Sam Tate et al 1 J. Rice . . . . . SW NE NW 28-4n-5w
Drilling 1,200 ft.

Jasper County

Lane 1 J. Huddleston . . . . . S½ SW NE 9-8n-10e
Derrick.
Anderson & Vorhees 1 A. Pippen . SE NW SW 16-8n-10e
McClosky 2,551 ft., T.D. 2,570 ft., 1,000 gal. acid, swabbed lost oil load, retreated with 2,000 gal., swabbed 15 bbl. an hr., mostly water. Now pumping 2 bbl. oil and 190 bbl. water per day, testing.
Pure 1 Dickerson-Harvey Con. . . . E½ NW NW 17-5n-10e
Rigging up rotary tools.
Jasper Oil 1 O. Poehler . . . . . N½ NE NW 7-5n-10e
Drilling 2,100 ft.
Pure 1 C. C. Price . . . . . W½ SW SW 16-6n-10e
Location.

Jefferson County

Obering & Phillips 1 A. F. Howe . . . NE SW SW 25-2s-1e
Drilling 1,385 ft.

Lawrence County

Robinson 1 Sauers . . . . . NW SE NW 20-3n-12w
Devonian 3,395 ft., drilling 3,411 ft.
W. Payne 1 H. Payne . . . . . NW SW NW 20-3n-11w
Drilling 295 ft.
United Drilling 1 Fornhoff . . . SW NW SE 27-2n-13w
Running tubing and rods, T.D. 2,721 ft.
Ky. Nat. Gas 4 Bierhaus . . . . . S½ NW SE 13-4n-11w
Moving in standard tools.

Madison County

Aich & Carroll 1 Rinkel . . . . . SE NE NW 33-5n-6w
Fishing 610 ft.
G. A. Fisher 1 F. C. Kiskadden . . SE SW NE 27-5n-8w
Set 12½-in. 32 ft., drilling 145 ft.

Marion County

Martin et al 1 Robinson . . . . SW SE SW 4-2n-1e
Trenton 5,268 ft., S.D. 4,396 ft.
Clevetin Prod. 1 E. Squibb . . . . S½ SE SE 29-3n-3e
Derrick.

Macoupin County

O. L. Smith 1 Klein . . . . . SE NW NE SE 7-9n-7w
S.D. 1,125 ft.
Bridges & Valbert 1 Felker . . . . . NW NE SW 1-9n-7w
Run 6⅝-in. 550 ft.

Montgomery County

W. L. Topf 1 Neiman . . . . . E½ E½ SE 30-8n-5w
Water 475-85 ft., drilling ahead, show gas 435-80 ft.
Thorpe & Grant 2 B. Woods . . . . . SW NW NW 32-11n-5w
Testing 612 ft.
W. L. Topf 1 Fisher . . . . . NE NE SW 19-9n-3w
Drilling 902 ft.
H. Greene 1 Unknown . . . . . SW SE NE 7-7n-2w
Location.

Pope County

L. V. Garvier 1 Peoples . . . . . NE NE NE 30-11s-5e
Derrick.

St. Clair County

Harris et al 1 City Park . . . . . NW SE 34-2n-9w
S.D. 1,629 ft.
B. W. Fitzgerald 1 Ittner . . . . . SE SW SE 9-1n-8w
Moving in standard tools.

Shelby County

J. Powell et al 1 P. H. Fritz . . . . . SE SE NW 23-10n-5e
Moving in tools.
J. Powell 1 Rincker . . . . . SW SW SE 22-10n-5e
Benoist 1,904-20 ft., pav 1,941-54 and 1,974-77 ft., Ste. Genevieve 1,999 ft., T.D. 2,138 ft., P.B. 1,972 ft., set 6⅝-in. 1,942 ft., tested mostly water from behind casing shoe, 20 and 10-qt. shots, 400 ft. fluid, 50 per cent water, T.D. 2,138 ft., P.B. 1,970 ft., cleaning out.

Tazewell County

Bartelmay 1 Mathis . . . . . SW NW SW 24-25n-3w
S.D. 324 ft.

Wabash County

C. A. Evarts 1 Hahn . . . . . NW SE NW 8-1n-12w
Machinery on ground.
Yingling 1 Seiler . . . . . NE SE SE 34-1s-13w
Glen Dean 2,087 ft., drilling 2,275 ft.
N. V. Duncan 1 Schroeder . . . . . SE SW SW 11-3s-14w
Glen Dean 2,276 ft., Golconda 2,380 ft., slight saturation 2,553-63 ft., drilling 2,630 ft.

Warren County

Monarch 1 F. Hoadley . . . . . NW NW 11-9n-1w
Drilling 495 ft.

Washington County

A. Borton et al 1 Edmiston . . . NE NE SW 5-2s-1w
Glen Dean 1,310 ft., Benoist 1,657 ft., S.D. 1,665 ft.
Lewis Lilly 1 Noble . . . . . NW NW SE 31-3s-4w
Drilling 275 ft.

White County

Carl Robinson 1 Taylor . . . . . S½ NW NE 11-5s-9e
8⅝-in. 122 ft., Kinderhook 2,140 ft., Menard 2,515 ft., drilling 2,655 ft.
O. O. Borden 1 I. McCallister . . . NE SE NE 7-5s-14w
Menard 2,139 ft., drilling 2,150 ft.
Noah & Morrison 1 S. Kershaw . . . . SW NW NE 22-3s-10e
Rigging up rotary.

Wayne County

Eason & Weinert 1 C. Bright . . . N½ NW NE 2-2s-7e
Waltersburg 2,373 ft., Golconda 2,740 ft., Cypress 2,855 ft., Benoist 3,029 ft., Ste. Genevieve 3,205 ft., Rosiclare 3,225 ft., Fredonia 3,260 ft., 5½-in. 3,300 ft., perf. 3,212-24 ft., 3,000 gal. acid, swabbed 49 bbl. oil and 10 bbl. water in 4 hr., testing.
Lavender & French 1 T. G. Puckett . NE NE NE 17-3s-8e
Menard 2,540 ft., Glen Dean 2,790 ft., Golconda 2,940 ft., base Golconda 3,033-38 ft., Cypress sand 3,070 ft., Paint Creek 3,177 ft., drilling 3,406 ft.

Rocky Mountain Area

(Continued from Page 242)

ducer and proves up considerable territory. It had the top of the Embar at 3,490 ft. and the Tensleep at 3,523 ft. It was acidized with 1,000 gal.

Cascade County

Bushford Synd. 1 Shannon-Roberts . SW NE 12-20n-1e
T.D. 3,100 ft., ran casing to 3,074 ft.

Daniels County

Copan Oil & Gas 2 Wiley . . . NW NW NW 10-36n-50e
Moving in rotary to resume at 1,928 ft., formerly White Tail Oil & Gas Co.

Garfield County

H. H. Schwartz, Jr., 1 Charles . . . SE NW 21-15n-30e
S.D. 3,528 ft.

Glacier County

Cut Bank had only one completion in Texas Co. 10 Unit 9, C SW SE 9-32n-5w, which swabbed 200 bbl. first 24 hours at 3,057 ft., total depth, from the Cut Bank sand at 3,008-47 ft. Main pay was at 3,035-43 ft.

There were five new operations.

Wm. Hanlon 3 Allotted-131 . . . . . SW SE NE 7-32n-5w
Rigging, first report.
Texas 6 Purdy . . . . . NW SW SE 35-35n-6w
Rigging, first report.
British American Oil 13 Tribal . . . C NE SW 34-35n-6w
Rigging, first report.
Kately, Agent 3 Kramer . . . . . NE SE NW 15-34n-6w
Rigging, first report.
Texas 2 Kneale . . . . . C NE NW 14-35n-6w
Location, first report.
A. R. Pardue 5 Tribal-171 . . . . SW SE SW 7-32n-5w
Drilling 1,125 ft., top Colorado 535 ft., 10¾-in. at 550 ft.
Glacier Prod. 3 Miller . . . . . NE NE 30-35n-5w
Drilling 1,455 ft., top Colorado 565 ft., 10¾-in. at 574 ft.
Glacier Prod. Co. 3 Rigney . . . . . SW NE 2-35n-6w
Drilling 2,190 ft.
Texas 9 Morrison . . . 660 ft. S of N¼ cor. 27-35n-6w
Coring at 2,860 ft.
Dakota-Montana 1 Tribal-112 . . SW NW NE 16-35n-6w
Standing at 3,015 ft.
A. B. Cobb 1 Tribal-187 . . . . . C SE NW 19-32n-5w
Cemented 7-in. at 2,809 ft.
R. A. Kullberg 1 Tribal-182 . . . . C NE NW 19-32n-5w
Spudded.
M. R. Wagner 3 Tribal-173 . . . SW SE SE 12-32n-6w
Drilling in at 2,966 ft., hole full of oil.

Phillips County

Montana-Dakota Utilities Co. had three completions and one new operation in the Bowdoin gas field.

No. 611, C Lot 7, 6-32n-33e, was completed at 1,026 ft. for 1,140,000 cu. ft. of gas with a rock pressure at 262 lb.

No. 612, CWL NE NE 7-32n-33e, was completed at 975 ft. for 813,000 cu. ft., pressure 267 lb.

No. 615, C SE SW 5-32n-33e, was completed at 1,000 ft. for 980,000 cu. ft., pressure 252 lb.

Montana-Dakota Utilities No. 619 . C SW SW 2-32n-33e
Spudded and S.D. (first report).
Montana-Dakota Utilities No. 616 . . C SE NW 5-32n-33e
Set casing at 771 ft., drilling in.

Stillwater County

Texas 1 Unit . . . . . SE NW 10-4s-19e
T.D. 7,116 ft., running Halliburton test.

Toole County

Kevin-Sunburst had one completion in Casper T. Oien 11 Engemoen, NW NE SW 11-35n-2w, which is pumping 25 bbl. a day at 1,634 ft., from the contact at 1,629-34 ft. It is not showing any water.

There were no new operations.

C. E. Biggs 1 . . . . . NE NW 22-37n-7e
Rigging up standard rig, Sage Creek district.
Pacific National Oils 10 Govt. . . . . SW SE SE 8-35n-2w
S.D. 590 ft.
Big West Oil 4 Ellingson . . . . CWL SW NW 14-35n-3w
T.D. 1,826 ft., dry in contact at 1,774 ft., breaks at 1,824-26 ft., acidized second time without results, will plug back and complete as gas well in Sunburst.
Coolidge & Coolidge 2 State . . . SE SW SE 26-36n-2w
S.D. 30 ft.
Mountain Gas 1-X Nelson . . . . . SE NE 12-35n-1e
S.D. 2,120 ft.
Pfabe & Engleking 13 Govt. . . . CNL SE SE 19-35n-2w
T.D. 1,518 ft., contact 1,518 ft., show of oil, standing.
Vander Pas 4 Ward . . . . . NE NW SW 28-35n-3w
T.D. 1,740 ft., show oil in contact at 1,728-40 ft., running tubing to acidize.
C. D. and H. O. Stock 6 Hagerty . SW SW 13-35n-2w
T.D. 1,579 ft., pumped 2 bbl. oil, 4 bbl. water, will acidize.
Kippen Oil & Gas 2 Solberg . CSL NW NE 20-35n-3w
T.D. 1,903 ft., good show oil in contact at 1,890-1,903 ft., acidized, testing.

Valley County

The Montana-Dakota Utilities Co. placed its 15-mile natural-gas line from Glasgow to Nashua in operation on November 1. This is an extension of the company's line from the Bowdoin field in Phillips County to Glasgow, a distance of 32 miles.

NORTHWEST NEW MEXICO

McKinley County

Ambrosia Investors Co., Inc., 1 Govt. SE SE 11-14n-10w
Drilling 1,200 ft.

San Juan County

Red Cactus Oil 1 Tribal . . . . . SE cor. 35-29n-18w
Drilling 675 ft., 8¼-in. at 660 ft.

San Miguel County

The Bell ranch in the eastern part of San Miguel County, New Mexico, consisting of 463,000 acres, is under lease to Harold C. Bishop of New York and not Humble Oil & Refining Co.

F. B. Plummer of Austin, Tex., and Chester Thomas, formerly of Tulsa, but more recently engaged by Dominican Seaboard Oil Co. in Santo Domingo, are now detailing structure and doing plane-table work on the Bell ranch for Mr. Bishop. There has been no exploitation agreement made with any major company, Mr. Bishop reports.

Southwest Drilling, Inc., 1 Conchas NW NE 34-17n-21e
Recementing 8¼-in. at 2,635 ft.

Permian Basin, Panhandle

(Continued from Page 241)

Truett & Tallmadge 1 Rudahl . . . . . NE SE 2-20-24
12½-in. 302 ft., drilling 692 ft.
Wills & Abell 1 Hale 12-20-30
6,000,000 cu. ft. gas from 1,540-60 ft., sulfur water at 1,823-24 ft., P.B. 1,528 ft., perf. casing 1,540-66 ft., est. 100,000 cu. ft. gas.
Dooley & Haynes 1 Martin . . . . . SE NW 9-18-25
T.D. 1,000 ft., running 5½-in. casing.
Knox & Featherstone 1 Hatchett . . SW NE 14-20-26
Set 8¼-in. at 377 ft., S.D. 625 ft.
Talmadge 1 State . . . . . SW NE 24-16-28
Slight show oil 2,505 ft., 10¾-in. at 358 ft., S.D. 2,605 ft.
Trojan 1 Grant . . . . . SW NE 33-20-25
Set 8¼-in. at 1,300 ft., S.D. 1,874 ft.
Clark & LaNeve 1 Boulter . . . . . SE NW 28-19-27
Show oil 1,126 ft., S.D. 1,250 ft.
Suddreth et al 1 Willis . . . . . SW NW 14-20-28
6 mi. W of Getty field, location.
Emmerson Brovles 1 Canfield SW SW NW 13-18-30
1 mi. NE of Kersey Creek discovery.
Fred Turner 1 DeVito 12-23-35
Top Dealware black lime 1,080 ft., drilling ahead 1,200 ft.

Lea County

Stanley & Weiner 1 Saunders . . . . . NE NE 20-21-38
T.D. 4,580 ft., S.D.
Great Western Prod. 1-D State . . . SE SE 30-12-32
T.D. 4,385 ft., P.B. to 3,048 ft., show oil 3,021-33 ft., perf. casing with 24 shots and bailed at rate of 6½ bbl. oil and 6½ bbl. water per 12 hr., tested 14 bbl. fluid per hr., 40 per cent water.

Otero County

R. H. Ernest 1 Located Land Co. . . . . SE SE 20-25-7
S.D. 3,729 ft.

Test to Be Started on Western Flank of Deer Park Anticline

By STAFF CORRESPONDENT

PITTSBURGH, Nov. 11.—During the past week in the lower eastern fields 32 operations were completed of which 2 were dry, 27 gas wells, and 3 oil producers. Interesting developments are reported from each division.

WEST VIRGINIA

A new interesting wildcat test has been announced that will test a new structure. In Randolph County, Cumberland and Allegheny Gas Co. will drill on the Elva Simmons farm in Valley Bend district. It is about 4½ miles S 30 W of Beverly, the former court house. It starts at an elevation of 2,030 ft. and is located on the west flank of Deer Park anticline.

In Ravenswood district, Jackson County, the two wildcats being drilled by Columbian Carbon Co. on the P. F. Riggs and F. F. Starcher farms are drilling at 2,245 ft. and 1,550 ft. In Poca district, the test drilling to the Clinton sand on the John Price farm has reached 5,972 ft.

In Grant district Harrison County, the deep rotary test of the Hope Natural Gas Co. on the C. S. Gribble farm is drilling at 7,760 ft. or 470 ft. below the top of the Oriskany sand. It is nearing the Newburg horizon.

Boone County

Sherman district: Pure 87 Federal Coal Co., 1,243,000 cu. ft. gas, Weir sand, R.P. 380 lb., T.D. 2,181 ft.

Braxton County

Birch district: Pittsburgh W. Va., 7,732 Ed L. Boggs former gas well, now making 45 bbl. oil a day along with 2,000,000 cu. ft. gas.
Pittsburgh & W. Va. 7,728 Flossie Snodgrass, 168,000 cu. ft. gas, Injun sand, T.D. 2,272 ft.

Cabell County

Grant district: Monickel Gas Co. 1 Oliver L. Locke, 235,000 cu. ft. gas, Big lime 1,508-1,675 ft., Big Injun 1,705-1,957 ft., Berea 2,221-41 ft., Brown shale 3,120-3,887 ft., Corniferous lime 3,887 ft.

Calhoun County

Sheridan district: Hope 1 F. E. Rothlisberger, former gas well, now flowing 25 bbl. a day, Maxton sand, T.D. 1,010 ft.

Gilmer County

Center district: Pittsburgh & W. Va. 7,742 C. N. Snodgrass, 356,000 cu. ft. gas, Injun sand, T.D. 2,139 ft.
DeKalb district: Roberts & Weekley 1 J. W. Stern, dry, Maxton sand, T.D. 1,497 ft.

Hancock County

Grant district: R. J. Braden Co. 59 C. E. Brenneman, 12 bbl., Berea, T.D. 895 ft.

Logan County

Logan district: O. B. Cunningham 1 John Justice, 800,000 cu. ft. gas, Big lime 1,768-1,950 ft., Big Injun 1,950-96 ft., no Berea, plugged back to Big lime at 1,950 ft., T.D. 2,440 ft.

Mingo County

Warfield district: M. C. Blackburn 2 Lucinda Chafin, 148,000 cu. ft gas Maxton sand, 68,000 cu. ft. gas brown shale; Maxton sand 1,207-22 ft., Big lime 1,322-1,484 ft., Big Injun 1,484-1,565 ft., Berea 2,038-2,145 ft., brown shale 2,145-2,875 ft., T.D. 2,875 ft.

Putnam County

Curry district: Jackson Gas Co., 1 W. C. Rupe, 200,000 cu. ft. gas, Big lime 1,425-1,575 ft., T.D. 1,575 ft., not shot.

Ritchie County

Murphy district: Hope 8,524 J. T. Reeevs, 450,000 cu. ft. gas, Injun sand, T.D. 1,926 ft.
Clem S. Morris 1 L. W. Cunningham, 42,000 cu. ft gas, Injun sand, T.D. 1,927 ft.
Union district: Mud Lick Oil & Gas Co. 3 R. M. Brissey, 69,000 cu. ft gas, Injun sand, T.D. 1,880 ft.

Roane County

Harper district: Boggess Drilling Co. 1 Harvey Jones, 681,000 cu. ft. gas, Salt sand, T.D. 1,612 ft.
American Oil Development Co. 1 Robert Romine, dry, Salt sand, T.D. 1,790 ft.

Upshur County

Buckhanan district: Pittsburgh & W. Va. 7,755 I. M. Allman, 35,000 cu. ft. gas, Benson sand 4,739-61 ft., gas 4,741-52 ft., T.D. 4,987 ft.
Meade district: Cumberland & Allegheny 300 Roy Williams, 285,000 cu. ft. gas, Gordon sand 2,009 ft., gas 1,971-2,005 ft., T.D. 2,029 ft.

Wayne County

Union district: Hale, Lowe & Francis 1 Perlie Brumfield (Basil S. Burgess) 550,000 cu. ft. gas; Big lime 1,170-1,335 ft., Big Injun 1,380-1,420 ft., Berea 2,005-15 ft., brown shale 2,400-2,865 ft., T.D. 2,875 ft.

ORISKANY GAS FIELDS

Kanawha County

Poca district: Glen Oil & Gas Co. 1 A. V. Olive, 846,000 cu. ft. gas, Corniferous 5,005 ft., Oriskany 5,117 ft., T.D. 5,158 ft., not shot.

DRILLING

Poca district: Godfrey L. Cabot 4 D. Holmes Morton, top Corniferous 4,862 ft.
Godfrey L. Cabot 12 Putnam Company, Corniferous, 5,100 ft.
United Carbon 1 Robert Wines, Corniferous, 4,858 ft.
United Carbon 1 William Wines, Corniferous, 4,886 ft.
United Carbon 1 Q. C. Tolley, Corniferous, 4854 ft.
D.H. Stephenson et al 1 R. B. Baldwin Corniferous, 4,712 ft.

NEW WORK

Boone County

Scott district: Owens, Libby-Owens, 33 Cassingham Coal Land Co., elev. 881.3 ft.

Braxton County

Birch district: Pittsburgh & W. Va., 7,700 Ida Young, elev. 1,271 ft.
Pittsburgh & W. Va. 7,773 Bessie Mollahan, elev. 1,035 ft.

Cabell County

Guyandotte district: George L. Starr 1 Russell E. Starkey, elev. 545 ft.

Gilmer County

Center district: H. M. Hunt and H. R. Adams, 1 G. O. Kennedy, elev. 992.37 ft.

Hancock County

Grant district: R. J. Braden Co. Nos. 73, 74, 75 C. E. Brenneman.

Jackson County

Ripley district: United Fuel Gas Co., 4,982 E. G. Scherr et al.

Kanawha County

Big Sandy district: United Fuel Gas 4,983 M. D. Shafer, et al.

Marshall County

Marshall district: J. T. McIntire Co. 1 W. C. Steger.

Pleasants County

Jefferson district: Leavitt & Black 1 C. T. Leavitt, elev. 880 ft.

Ritchie County

Grant district: Reno Oil Co. 1 W. D. McIntire, elev. 872 ft.

Randolph County

Valley Bend district: Cumberland & Allegheny 303 Elva Simmons, elev. 2,030 ft.

Taylor County

Booths Creek district: Pittsburgh & W. Va. 6,113, Fannie R. Brightwell, elev. 1,247 ft.

Wayne County

Stonewall district: Owens, Libby-Owens, 23 Hoard-Baldwin, elev., 1,052.2 ft.
Union district: United Carbon 1 L. B. Ferguson, elev. 950 ft.

Wetzel County

Proctor district: Manufacturers Light & Heat 2 August Blatt, elev. 1,089 ft.
Manufacturers Light & Heat 1 Henry Homan, elev. 1,127 ft.

SOUTHWEST PENNSYLVANIA

On Chestnut Ridge in South Union Township, Fayette County, Peoples Natural Gas Co. are assured of a commercial well in 2 Piedmont Coal Co. In the Onondaga lime, the first gas pay in the chert beds was struck at 6,428 ft. which finally gauged 280,000 cu. ft. gas a day. At 6,464 ft., additional gas was struck which increased the volume to 1,200,000 cu. ft. gas. It was shut in for test and the rock pressure was 2,220 lb., slightly greater than in the other wells now producing. It is now drilling at 6,481 ft. This company's No. 3 is drilling at 3,647 ft.

South along the ridge, New Penn Development Co., William E. Snee are spudding 3 Summit Hotel (Heyn). In North Union Township, Wasson and others are drilling at 6,368 ft. in 2 J. H. Sorg with the Tully lime topped at 6,350 ft. or subsea 3,839 ft. placing it about 143 ft. lower than 2 Piedmont Coal. There was no change in Laurel Ridge nor in Maryland where a bailer is being fished in 1 Humberson, on Accident Dome in Garrett County and at a depth of 6,830 ft.

Allegheny County

Shaler Township: Price Bros. 1 Kate Dressel, small gas well, Thirty-foot sand, T.D. 1,750 ft.
West Deer Township: Harbison et al 1 McIntyre, 352,000 cu. ft gas, Thirty-foot sand, T.D. 1,701 ft.

Armstrong County

Cowanshannock Township: Peoples 1 Michael Miketa, 267,000 cu. ft. gas after shot, Bradford sand, T.D. 3,585 ft.
Kittanning Township: Local Co. 1 G. A. Scholl, 63,000 cu. ft. gas, Hundred-foot, Speechley, and Bradford sands, T.D. 3,450 ft.

Clarion County

Porter Township: Squirrel Hill Gas Co. 1 Charles Fagley, 170,000 cu. ft. gas, Murraysville and Hundred-foot, T.D. 2,640 ft.

Fayette County

Nicholson Township: Duquesne 1 George Moher, 300,000 cu. ft. gas, T.D. 2,386 ft.

Greene County

Richhill Township: Natural Gas Co. of W. Va., 2 Harry Coffield, 126,000 cu. ft. gas, Fifth sand, T.D. 3,220 ft.

Washington County

Nottingham Township: Beedle & Clark, 1 Pittsburgh Coal Co., 20,000 cu. ft. gas, Gantz sand, T.D. 2,730 ft.
Somerset Township: Carnegie 1 Elizabeth Nicholls, 169,000 cu. ft gas, second Salt sand, T.D. 1,425 ft.

Westmoreland County

Bell Township: Peoples 1 John McCreary, 2,087,000 cu. ft. gas, 3,090-96 ft., T.D. 3,097 ft.

DRILLING

Allegheny County

Findlay Township: Oscar O. Goss et al 1 C. F. Chubb, 1,360 ft.
Franklin Township: Charles B. Wachter 1 Joseph Pierce, 350 ft.

Armstrong County

Bethel Township: T. W. Phillips 1 Mrs. H. E. Gilchrist, 1,275 ft.
Boggs Township: J. K. Sharp et al 1 Joseph Sefton, rig.
Burrell Township: Equitable Gas Co. 1 Mrs. George Cravener, cleaning out at 1,550 ft. to deepen.
Cowanshannock Township: Peoples 1 James McKinney, 2,510 ft.
Wm. McCollins et al 1 A. L. McCullough, location.
T. W. Phillips 2 Harrey Boyer, 120 ft.
Equitable Gas Co. 1 J. H. Hoover 2,525 ft.
Shelocta 1 Park Rearick, location.
East Franklin Township: Leithold Gas Co. 1 John Roofner, casing 627 ft.
Kiskiminitas Township: Shaw & Townsend 1 Michael Zitterberg, 2,104 ft.
Apollo Gas Co. 2 J. P. Wilson Heirs, 104 ft.
Kittanning Township: Local Co. 1 B. H. Shreckengast, 1,355 ft.
Equitable 1 David Shoemaker, 3,247 ft.
Plum Creek Township: Shelocta 2 Harry Kough, location.
Wayne Township: Penn Wayne 2 Ed Clever, 2,690 ft.
Daniel Sowers et al 2 William Rupp, 2,090 ft.
Louden Drilling Co. 1 Armstrong Trust Co., 375 ft.

Clarion County

Monroe Township: Owens Illinois Glass 1 J. C. Heinrick, fishing.
Porter Township: Gourley Gas Co. 3 Andrew Gourley, spudding 30 ft.
Squirrel Hill Gas Co. 2 Charles Fagley, location.
Piney Township: Frank Shreffler 8 Clarion County Home, 175 ft.
Red Bank Township: Mayport Clay Co. 1 Samuel Wyncoop, 642 ft.
T. W. Phillips 1 E. C. Buffington, 1,455 ft.
T. W. Phillips 1 D. I. Miller, 1,010 ft.

Fayette County

German Township: J. H. Carnell 1 Albert Lily, 730 ft.
Menallen Township: Eberly, Snee et al 1 Bachman, location.
Nicholson Township: Greensboro Gas Co. 1 George Lecrone, spudding.
Greensboro Gas Co. 1 Frank Mozo, 1,355 ft.
Duquesne 1 Hattie Talbert, rigging up.
Wahler Powers 1 McKeefry Coal Co., 1,075 ft.

Greene County

Aleppo Township: Peoples 1 S. N. Rinehart, 3,110 ft.
Center Township: Devins et al 1 Hugh Smith, 1,400 ft.
Jackson Township: Equitable 1 Ocie M. Kerr, 2,575 ft.
Drummage et al 1 Frank Gilbert, 3,000 ft.
Monongahela Township: Mayne et al 1 Stephenson, 1,057 ft.
Greensboro Gas Co. 1 Charles Hopton, rig standing.
Harry Scott et al 1 Silas Provins, S.D. 310 ft.
Morris Township: Romney Rutan et al 1 I. J. Clutter, moving in.
Richhill Township: Carnegie 2 Ella Sowers will deepen.
Whiteley Township: Lewis Petit et al 1 Shields, 1,319 ft.
Waynesburg Home Gas Co. 2 A. J. Morris, 2,590 ft.
Greene County Gas Co. 1 James Orndoff, 2,930 ft.

Westmoreland County

Allegheny Township: Apollo Gas Co. 2 Sadie J. Anderson, 612 ft.
Hyde Park Foundry Co. 2 Andrew Grinder, 3,085 ft.
Bell Township: Peoples 1 J. A. Kuhns, 2,400 ft.
Washington Township: Peoples 1 J. T. George, 190 ft.

Washington County

Amwell Township: Chivers et al 2 James Bristor, 1,600 ft.
Carnegie 1 D. C. Blake, will deepen.
Carnegie 4 Redd, 2,790 ft.
Morris Township: South Penn 1 Oliver Booth, 585 ft.
Somerset Township: Carnegie 2 J. D. Amos, 40 ft.
Equitable Gas Co. 1 Riffle, 1,345 ft.

South Franklin Township: H. V. Sprowls et al 2 Clarence Vankirk, 900 ft.
West Bethlehem Township: George Gray et al 1 Harry Long, 2,410 ft.
J. D. Amos et al 1 Frank Myers, rigged up.

West Central Texas

(Continued from Page 244)

General Crude Oil 12 Flanigan, center of old Royston field, Ordovician test, drilling 4,250 ft.

Hamilton County

A. J. Caldwell 1 W. W. Jones, 1,002 ft. from NE, 150 ft. from SE lines, W. H. Crowder Sur., rigging up to drill deeper below 3,010 ft.
C. J. Meyers 1 Oats, 420 ft. from S and 1,035 ft. from E lines, F. Hughes Sur., 4,000-ft. test, casing set at 3,400 ft., preparing drill ahead.

Menard County

Harry Baldwin 1 Leggett, SW SW Sec. 1, B.S.&F. Sur., drilling 550 ft.

Jones County

Pearson 1 Carlson, SE W½ N½ Sec. 1, Blk. 5, H.&T.C. Sur., Palo Pinto test, surface casing set, prepare drill ahead.

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Danciger Oil & Refg. 1 Nelson, SW cor. Lot 82, De Witt Co. Sch. Lds. Sur. No. 126, prepare spud.

Nolan County

Arthur Harvey 1 L. N. McRee, SW NE Sec. 43, Blk. 19, T.&P. Sur., 5,200-ft. test, location.

San Saba County

Three Widows Oil 1 Ballard, NW cor. S½ Sec. 80, H. Behrenroth Sur. 506, 2,000-ft. test, T.D. 1,150 ft., last report.

Shackelford County

Carson 1 Elliott, Sec. 49, B.A.L. Sur., resumed drilling after being S.D. at 1,685 ft., Caddo lime test to 3,620 ft., saturation in Caddo lime 3,614-40 ft., treated 100 gal. acid, swabbing est. 50 bbl. oil per day, preparing treat again with 1,500 gal.
Georgian Oil Corp. 2 Blach, 1,290 ft. from SE and 540 ft. from SW lines Sec. 391, T.E.&L. Sur., deep test, location.

Taylor County

Ce-beth Oil 1 City of Abilene, south shore of Lake Abilene on city property, 4,000-ft. test, corrected report, drill pipe stuck, T.D. 1,940 ft., S.D.
K. B. Nowles 1 Hardin-Simmons Univ., S½ NW Sec. 36 Lunatic Asylum lands, 9½ mi. S Abilene, S.D. 38 ft.

Throckmorton County

Humble 1 Durham, Sec. 1627, T.E.&L. Sur., 10-in. at 690 ft., drilling 2,830 ft.

Oklahoma Fields

(Continued from Page 232)

Wagoner County

Wildcat: Claude Jordan 1 Meriwether, NE NE NE 16-18-17, Mississippi 554 ft., T.D. 903 ft. in sand, gaged 1,200,000 cu. ft. gas.
Bilby area: Johnson & Bailey 1-A Thompson, C NW NE 22-19-15, T.D. 932 ft., pumped 5 bbl.
Miscellaneous: James Pet. 3 Robinson, 21-19-15, Dutcher 1,010-18 ft., shot with 40 qt. by Mid-Continent Torpedo, small oil well.

WILDCAT REPORTS

Caddo County

Ray Stephens 1 Lankford ..... SE SE NW 6-6-9w
Drilling 2,135 ft.
Texas 1 Smith ..... C NE NW 2-5-12w
Drilling 4,373 ft.

Comanche County

Hilton Phillips 1 Reick ..... NW NW SW 29-4-10w
Setting casing 162 ft.

Cotton County

E. R. Stewart 1 Emery ..... NE NE NE 30-3s-13w
Old T.D. 2,503 ft., drilling 2,548 ft.

Creek County

Irvin Drlg. 1 Bailey ..... SE NE SE 1-18-9
T.D. 1,927 ft., S.D.

Hughes County

Magnolia 1 McKoy ..... SW SW SE 16-5-11
Booch sand 2,779 ft., dry, drilling 3,760 ft.
Don Feagin et al 1 Fulks ..... NE NW SW 8-9-11
Setting 6-in. 2,485 ft.

Jackson County

G. R. Burke 1 Estes ..... SW SW NE 34-3-19w
Drilling 860 ft.

Kay County

Union Natural 1 Long ..... NW cor. 29-28-1
Old T.D. 1,670 ft., drilling 2,100 ft.

Kiowa County

Dempsey & Son 1-A Dempsey ..... NW SW NE 31-4-18w
S.D. 40 ft.
Hurst & Groth 1 A Groth ..... SW cor. 3-4-16w
Drilling 450 ft., new hole.
Artie Baker 1 Coakley ..... NW NE SE 30-7-17w
Show gas 820-28 ft., show oil 830-35 ft., drilling 860 ft.

Lincoln County

Mason & Stuart 1 Crane ..... SW NE SE 7-12-5
T.D. 4,242 ft., pumped 81 bbl. oil in 24 hr.

Logan County

Big Chief & Ellison 1 Strange ..... C SW SE 27-18-4w
Drilling 1,900 ft.

Love County

Colvin & Hicks 2 Westheimer ..... C W½ SE SW 27-6s-2
T.D. 2,907 ft., casing parted at 1,900 ft., S.D. for casing.

McIntosh County

McNutt & Young 1 Life ..... SE SE SW 1-12-16
Booch 1,473-85 ft., T.D., gaged 1,930,000 cu. ft. gas.

Okfuskee County

Portable Drlg. 1 Walker ..... SW NW SW 17-13-7
Bartlesville 3,153 ft., show oil, T.D. 3,188 ft., S.D.
Vierson et al 1 Leonard ..... SW SE NW 11-13-7
T.D. 3,594 ft., flow 7 bbl. oil and 65 bbl. water in 24 hr.
Davon Oil 1 Sporleder ..... C SW NW 35-12-9
T.D. 3,978 ft. in Hunton.
W. O. Carte 1 Bucco ..... NE NE SE 20-10-12
T.D. 875 ft., setting 8-in. casing.

Osage County

Oklahoma Natural 1 Osage ..... NW NW NE 29-22-12
Drilling 1,000 ft.

Pontotoc County

Catlett et al 1 James ..... NW NW NE 19-5-4
Trenton lime 2,765 ft., coring 2,880 ft.
Heintzelman & Theodore 1 Crawford ..... NE NE NW 12-4-6
Drilling 435 ft.

Pottawatomie County

J. F. Smith 1 Maud ..... SE SW SE 27-8-5
Mayes 3,836 ft., Woodford 3,970 ft., Viola 4,218 ft., drilling 4,355 ft.
Vierson O. & G. 1 Meyers ..... SE NE NE 1-11-6
Drilling 205 ft.

Seminole County

Amerada 1 Campbell ..... N½ SW SW 30-9-6
Dense 4,170 ft., drilling 4,181 ft.

Stephens County

Halliburton 1 fee ..... SE SW SW 5-1s-7w
Drilling 597 ft.

Sun Oil 1 Boring ..... NE SW NW 9-1s-4w
Dry sand 6,225-40 ft., T.D. 6,310 ft., P.B. 5,700 ft. to test.
Brown et al 1 Dilly ..... C SE SE 6-3s-5w
T.D. 1,838 ft., P.B. 1,350 ft., bailed dry, light show oil, moved tools out.
G. L. Pace et al 1 Miller ..... NW NE NW 13-3s-5w
Arbuckle lime 2,711 ft., T.D. 2,741 ft., will P.B. to 952 ft. and test.

Tillman County

Price et al 1 Crow ..... NW NW NE 24-2s-15w
Drilling 985 ft.

Woods County

Gulf 1 Hess ..... C NE NW 33-23-13w
Drilling 4,960 ft.

FIRST REPORTS

Carter County

Magnolia 82 Richards ..... CSL 31-3s-3w
Jones 2 Daugherty ..... NE SW SE 17-4s-2w
Neustadt 2-A Bennett ..... SE SW NW 17-4s-2w
Smith 2 Ward ..... CNL NE 19-4s-2w
Gibson & Jennings 5 Griffin ..... SW NE SE 20-4s-2w
Carter 7 Walker ..... SW NW SW 20-4s-2w
Turner 5 Stearns ..... NE SW SW 21-4s-2w
Turner 6 Stearns ..... NE SW SW 21-4s-2w

Kiowa County

Dempsey & Son 1-A Dempsey, wildcat ..... NW SW NE 31-4n-18w
Hurst & Groth 1-A Groth, wildcat SW SW SW 3-4n-5w

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California Dry Gas Reserves

By L. P. STOCKMAN

LOS ANGELES, Calif.—Although California dry gas fields have not yet become of economic importance, as gas produced with crude oil has been given priority in the channels of commerce, this group will eventually assume a more pronounced position in supplying the future demand for natural gas. There is very little likelihood, however, that the dry gas fields will go on steady commercial production within the next few years due to the large reserves of gas in primary oil fields now undergoing development. Several gas fields are being allowed to produce a relatively small volume of gas in order to provide greater flexibility of operation and facilitate distribution to areas somewhat remote from the main trunk transmission lines of the principal distributing utilities but as a rule they are being used as standby units. The McDonald Island field of San Joaquin County heads the list with a cumulative production of 8 billion cubic feet of dry gas to date followed by Buttonwillow gas field of Kern County with a production of nearly 17 billion cubic feet. Natural gas from Goleta goes south to southern California and gas from Buttonwillow is moved northward to the San Francisco Bay region.

A total of more than 1 trillion cubic feet in dry gas fields is waiting for a market that appears several years away. Only about 80 billion cubic feet of gas has been produced by the various dry gas fields up to the present, excluding that used during drilling operations, and also excluding dry gas zones in proved oil fields. On the assumption that 10,000 cu. ft. of gas is the equivalent of 1 bbl. of crude oil, the 1,011,289,000,000 cu. ft. of gas, expected to be produced from existing dry gas fields, is the equivalent of about 101,128,000 bbl. of crude and at 10 cents per thousand cubic feet represents a value of approximately $101,128,000.

The greater part of all gas distributed to domestic consumers and manufacturing establishments in California up to the present has been gas from oil fields. Kettleman North Dome field, discovered by Milham Exploration Co. October 5, 1928, is the largest producer of gas in the state as this field, which is nearly 12 years old and the largest in California, is still producing about 40 per cent of the total gas produced.

The Rio Vista gas field which extends across Solano and Sacramento counties is by far the largest gas field in the state both with respect to the acreage proved and total future expectancy in production. Rio Vista has been given a possible ultimate production of 750,000,000,000 cu. ft. and while this appears rather large it is considered conservative by operators familiar with the structure and production characteristics of the field. The district has been credited with having a total of 15,000 acres proved as productive and this may be considered as ultra conservative. Rio Vista is without doubt the best gas field discovered to date from all angles and should show large production as it has two well defined gas zones that show an average porosity of 35 per cent. Production to date is about 12 billion cu. ft.

Buena Vista Lake

The Buena Vista Lake gas field is 18 miles southwest of Bakersfield in Kern County, California. The nearest producing oil field is the Cole's Levee field which lies off the east tip of Elk Hills in the San Joaquin Basin. The Buena Vista Lake gas field was discovered in 1934 by Ohio Oil Co. as exploration by reflection seismograph in 1933 revealed an anticline of sufficient structural closure to warrant a test.

The dry gas is collected by a local gathering system and is delivered to the transmission lines of the Southern California Gas Co. for distribution in southern California. To date, the reserve has not been drawn upon continuously, but is used as a stand-by for Los Angeles Basin consumption. A total of nine wells has been drilled but only five are productive. Drilling operations have definitely outlined the structure in the gas zone, revealing it as a closed anticline featured by gentle dips. The axial trend is about N. 50° W., and the structure is several times as long as it is wide. Productive closure, as demonstrated by drilling, is less than 50 feet. The field covers approximately 1,000 productive acres.

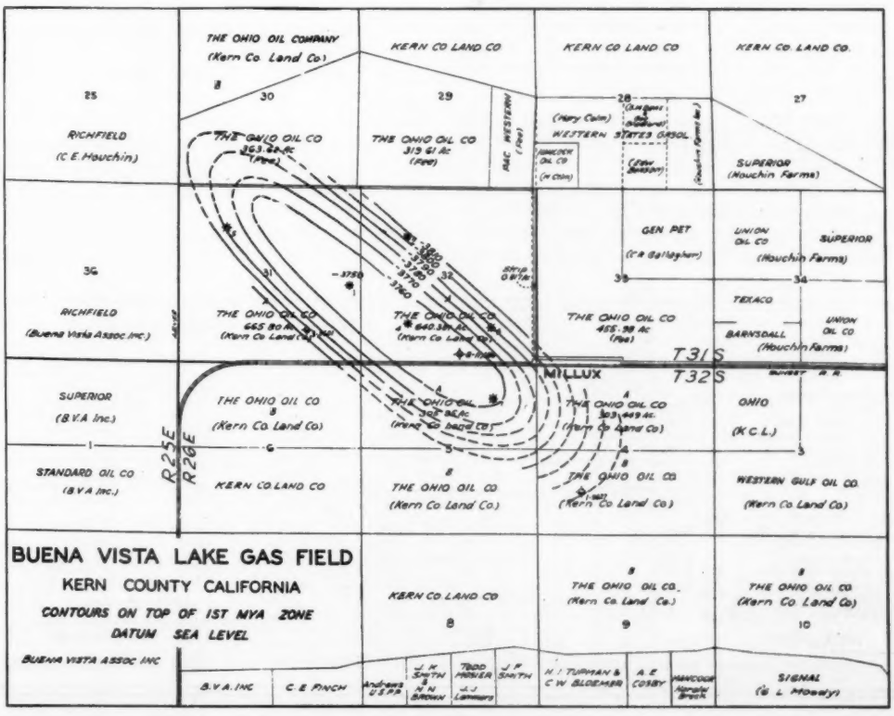
Stratigraphy

A fairly complete composite log can be made up from the cored sections of the two deep wells, Nos. 1-A and 8-A Kern County Land, that have been drilled on the structure to date. In general, the section is stratigraphically similar to that of the Ten Section and Canal fields farther north. The Tulare formation is encountered at 4,045 ft. These Pleistocene sediments are composed of sands, sandy clays, siltstones, and claystones. From 4,045 ft. to approximately 5,050 ft., the section is that of the San Joaquin clays (upper Pliocene). Within this zone, the sediments are largely claystones and siltstones, with thin sands up to 15 ft. in thickness. Several fossil markers occur in this series, together with three productive gas zones. The sands are fine to coarse with fair porosity. Undifferentiated Etchegoin sands and Jacalitos (Pliocene) occur between 5,505 ft. and about 9,200 ft. This section, as cored and drilled, is known to be made up largely of alternating sands and siltstones or claystones down to about 8,000 ft., and consists almost entirely of firm to hard shales and siltstones from 8,000 ft. to about 9,200 ft. From about 9,200 ft. to 10,000 ft., the sediments are upper Miocene in age. It is in this range the drilling becomes progressively more difficult. The hard, gray to brown shales of this interval becomes increasingly harder with greater depth. Not far above the Miocene sand zone, a hard cherty or siliceous shale zone occurs for 100 ft. or more, and may be of considerable value in correlation work. The Miocene sand zone, from about 10,000 ft. to 11,000 ft., is probably the equivalent of the Ten Section or Stevens sand. This zone consists of alternating hard to firm sands and hard brown shales. Some of the shales are exceedingly hard and resistant to drilling, and the sands vary greatly in grain size and porosity. While considerable oil saturation was a feature of the sands in this zone, No. 8-A Kern County Land was abandoned after exhaustive attempts to make it produce had failed to result in satisfac-

CALIFORNIA NATURAL GAS PRODUCTION AND DISTRIBUTION BY YEARS

(In M.c.f.)

Year	Production	Utilization	Lost or blown to air
1920	68,650,000	62,630,000	6,020,000
1921	82,000,000	72,000,000	10,000,000
1922	120,600,000	93,000,000	26,600,000
1923	319,262,352	129,148,352	190,114,000
1924	248,519,406	121,097,406	127,422,000
1925	236,646,717	145,152,717	91,494,000
1926	274,364,773	189,084,773	85,280,000
1927	293,435,459	219,250,459	74,185,000
1928	316,830,147	239,239,423	77,590,724
1929	557,634,175	309,157,574	248,476,601
1930	555,145,655	228,753,165	326,392,490
1931	385,201,300	316,723,000	68,478,300
1932	281,408,795	246,320,615	35,088,180
1933	273,942,355	255,122,125	18,820,230
1934	288,132,460	268,283,395	19,849,065
1935	318,988,100	294,114,080	24,874,020
1936	342,964,585	318,590,615	24,373,970
1937	354,228,120	335,994,180	18,233,940
1938	377,111,795	344,255,225	32,856,570
1939	376,016,065	342,762,640	33,253,425


BUENA VISTA LAKE GAS FIELD
KERN COUNTY CALIFORNIA
CONTOURS ON TOP OF 1ST MYA ZONE
DATUM SEA LEVEL
BUENA VISTA ASSOC INC
THE OHIO OIL COMPANY (Kern Co Land Co)
KERN CO LAND CO
KERN CO LAND CO
KERN CO LAND CO.
RICHFIELD (C E Houchin)
THE OHIO OIL CO
THE OHIO OIL CO
SUPERIOR (Houchin Farms)
GEN PET
UNION OIL CO
SUPERIOR (Houchin Farms)
RICHFIELD (Buena Vista Assoc Inc)
THE OHIO OIL CO
THE OHIO OIL CO
TEXACO
BARNSDALL (Houchin Farms)
UNION OIL CO
MILLUX
T31S
T32S
SUPERIOR (B.V.A. Inc.)
THE OHIO OIL CO (Kern Co Land Co)
THE OHIO OIL CO
OHIO (K C L.)
STANDARD OIL CO (B.V.A. Inc.)
R25E
R26E
KERN CO LAND CO
THE OHIO OIL CO (Kern Co Land Co)
THE OHIO OIL CO (Kern Co Land Co)
WESTERN GULF OIL CO (Kern Co Land Co)
KERN CO LAND CO
THE OHIO OIL CO. (Kern Co Land Co.)
THE OHIO OIL CO (Kern Co Land Co)
B.V.A. INC
C. E. FINCH
SIGNAL (G. L. Mosely)

tory production. The relatively small initials shown by gas wells completed by Ohio Oil Co. in the Buena Vista Lake gas field are somewhat misleading unless attention is called to the fact that the initials do not represent maximum production. No pipe line facilities were available during the period of development and the company was not interested in establishing maximum potential production. The Buena Vista Lake gas field has since been provided with adequate pipe line facilities and will ultimately prove highly productive notwithstanding the field has up to the present been used only as a stand-by supply to meet peak loads during period of high consumption in southern California.

Delano Gas Field

The Delano (Trico) gas field of Kern and Kings counties is in the center of the San Joaquin basin about 37 miles northwest of Bakersfield. Topography consists of relatively flat sagebrush land with little or no surface indication of structure. Approximately half of the productive acreage is in Kings County and the other half in Kern County, the separatrix bisecting the field in an east-west direction. The Delano gas field structure was located by seismograph survey and is an anticlinal dome. Production is found in the top of the San Joaquin clay series in the upper Pliocene sediments. Two zones, the first Mya and the second Mya, are productive in two places. The productive zones vary in thickness from 25 ft. to 100 ft. and consist of about 25 per cent sand. Initial pressures ranged from 1,060 lb. to 1,390 lb. and latest shut-in pressures ranged from 1,050 lb. to 1,325 lb.

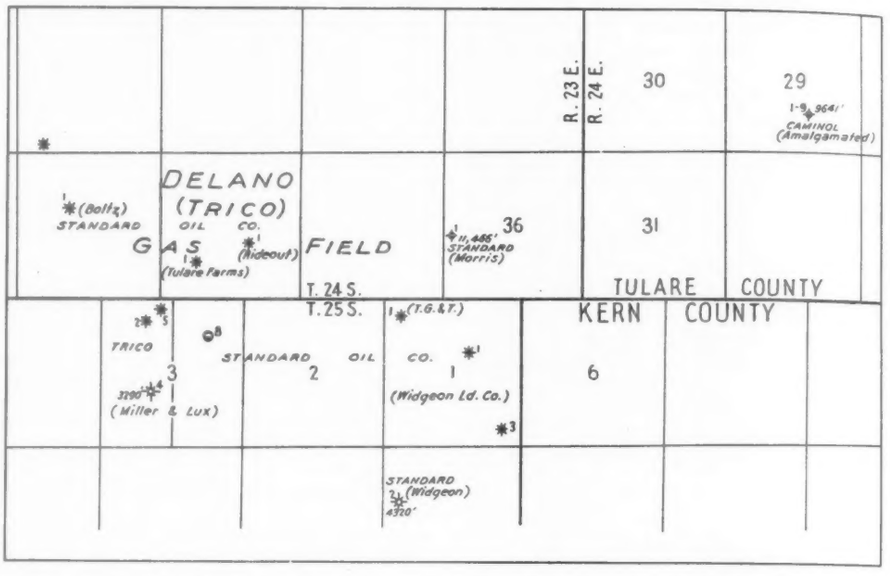
The Delano gas field was discovered by Trico Oil & Gas Co. on November 18, 1934. The field is not expected to show a high ultimate unless deeper productive zones are discovered because the productive zones are relatively thin. Pacific Gas & Electric Co. and Southern California Gas Co. provided the field with a jointly operated pipe line outlet last year by laying 14 miles of 8-in. line to their Buttonwillow-San Francisco-Los Angeles main trunks. The new line cost approximately $125,000 and gave the Delano gas field its first outlet since completion of the discovery well in 1934. Productive capacity of the field is about 35,000,000 cu. ft. per day but it may require some additional drilling to maintain this rate when the district goes on steady production. The field has been produced only during the winter months when consumption reaches its peak.

The Chowchilla gas field of Madera County, California, which appears to have only limited commercial production possibilities at the present time, was discovered by Pure Oil Co. April 2, 1935. The gas produced in the Chowchilla gas field has the lowest B.t.u. value of any dry gas field in the state. Gas from the upper zone has a calorific value of 930 Bt.u. but gas from the lower horizon contains 56½ per cent inert nitrogen and hence the B.t.u. value is too low for commercial purposes. No drilling has been done in the field for about 4 years and the relatively large reserve of gas with more favorable heating value and better operating conditions in other fields indicates the Chowchilla gas field will probably remain inactive for an indefinite period.

Willows Gas Field

Ohio Oil Co. discovered a new productive gas field in the Willows area along the west side of the Sacramento Valley in Glenn County when No. 1-A Willard in Section 18-20-2 was brought in flowing 5,356,000 cu. ft. through a 42/64-in. bean from 2,364 ft. This field is about 135 miles northeast of San Francisco and the discovery well was finished in 1938. The importance of this field can be determined only as a result of additional development, although the initial well that blew out and was destroyed showed a volume large enough to justify the expectation of a commercial accumulation of primary importance.

Buttes Oilfields, Inc., has found a commercial gas field about 14 miles west of Marysville on the southerly flank of the Sutter or Marysville Buttes in Sutter County. This company has drilled four wells on the structure. No. 4 was the best completion as it showed an initial of 24,600,000 cu. ft. from 5,855 ft. Production is coming from the Cretaceous topped at about 2,500 ft. and from a zone approximating 30 ft. in thickness. Drilling operations have progressed far enough to indicate existence of a good gas field as No. 4 showed a shut-in pressure of 3,100 lb. a few days after completion. Pacific Gas & Electric Co. provided the field with an outlet late in 1938 and the field has been on steady but restricted production since early in December 1938. Buttes Oilfields, Inc., has a lease on 44,000 acres on the Marysville Buttes and has sufficient acreage to justify extensive development. The gas from this field, based on a calorimeter test, is 1,016 B.t.u., the third highest heating value natural gas in the state. Since the company placed a resident engineer in charge of geological and engineering work considerable strides have been made in drilling and production practice. Walter Stalder, a consulting geologist of San Francisco, recognized the potentialities of this structure several years ago and was for a time a member of the board of directors of Buttes Oilfields, Inc., which is finally getting into production after a long and sometimes discouraging campaign.



The Marysville Buttes have been formed by a volcanic intrusion that has cut through all of the great thickness of Cretaceous rocks underlying the Sacramento Valley. The former volcano of the Marysville Buttes is surrounded by a ring of sediments which from their outcrops are found to consist of the Chico (Cretaceous) rocks, of Eocene beds and of later Miocene and Pliocene gravels, sands, and clays. These sediments are capped and hidden in part of remnants of the volcanic cone which slopes gently toward the central volcanic mass. As a matter of comparison, it might be mentioned that this sedimentary basin of the Sacramento Valley involves an area approximately 10 times as large as Los Angeles Basin.

CALIFORNIA NATURAL GAS FIELDS

	County in which located	Date of discovery	Calorific value B.t.u.	Proved acreage	In thousands of feet— Estimates ultimate production	Production to Jan. 1, 1940	Remaining to be produced	Name of purchasing company
Northern group:								
Eureka	Humboldt	Sept. 15, 1937	940	*100	Undetermined	None	Undetermined	No outlet
Fairfield Knolls	Yolo	May 15, 1937	960	*100	Undetermined	15,000	Undetermined	No outlet
McDonald Island	San Joaquin	June 2, 1936	965	1,500	100,000,000	18,000,000	82,000,000	Stanpac
Potrero Hills	Solano	Dec. 15, 1938	991	*100	Undetermined	None	Undetermined	No outlet
Rio Vista	Solano and Sacramento	June 18, 1936	1,040	8,500	730,000,000	11,861,000	718,139,000	Pac. Gas & Elec. Co.
Sutter Buttes	Sutter	1933-1937	1,016	*500	25,000,000	1,500,000	23,500,000	Pac. Gas & Elec. Co.
Tracy	San Joaquin	Aug. 11, 1935	935	600	25,000,000	8,100,000	16,900,000	Stanpac
Willows	Glenn	Aug. 10, 1938	990	*100	20,000,000	None	20,000,000	No outlet
San Joaquin Valley:								
Buena Vista Lake	Kern	July 3, 1934	1 000	875	40,000,000	2,500,000	37,500,000	South. Calif. Gas Co.
Buttonwillow	Kern	Nov. 3, 1926	*985	1,000	34,500,000	16,750,000	17,750,000	Pac. Gas & Elec. Co.
Chowchilla†	Madera	April 2, 1935	990	*300	Undetermined	None	Undetermined	No outlet
Delano (Trico)	Kern	Aug. 1, 1935	980	2,000	20,000,000	4,200,000	15,800,000	P.G.&E. & So. Cal. Gas Co.
Semi-Tropic	Kern	Feb. 12, 1932	980	3,750	22,500,000	2,900,000	19,600,000	Pac. Gas & Elec. Co.
Coastal area:								
Goleta	Santa Barbara	Aug. 5, 1929	1,035	250	75,000,000	14,900,000	60,100,000	South. Calif. Gas Co.
Total				20,375	1,092,000,000	80,726,000	1,011,289,000	

*Arbitrary estimate pending additional development. †Gas of second zone at 8,300 ft. level contained 56½ per cent inert nitrogen and hence low-calorific value.

New Gas Field Is Found in South Saskatchewan

By VICTOR LAURISTON

CHATHAM, Ont., Nov. 9.—Official figures show that crude and naphtha production from all Canadian fields for the first 8 months of 1940 totaled 5,426,813 bbl. compared with 5,066,251 bbl. in the same period last year. New Brunswick production declined from 13,087 to 11,962 bbl. and Ontario from 138,706 to 124,338 bbl. Alberta production increased from 4,899,258 to 5,279,235 bbl. and that of the Northwest Territories was down from 15,200 to 11,278 bbl.

Natural-gas production in August totaled 1,582,755 M.c.f. for all Canadian fields against 1,877,900 M.c.f. in the same month last year. For the 8 months of 1940 the output was 23,319,949 M.c.f. against 22,842,304 M.c.f. in the 1939 period.

New Saskatchewan Gas Field

In the Bishopric area, in southern Saskatchewan 33 miles south of Moose Jaw, a test drilled by Natural Sodium Products to secure crude for their sodium sulfate plant and oil refinery struck gas at 1,500 ft., with a flow estimated 15,000,000 cu. ft. a day and 1,000 lb. pressure. Test will be deepened about 50 ft. The strike opens an entirely new and previously untested gas area in the south of the province, about 15 miles north of the Montana line.

Kamsack Field

In eastern Saskatchewan, a considerable shallow gas field has been developed near Kamsack. The discovery well, drilled by Coal Gate Oils in 1938, is maintaining close to its initial flow and pressure. Of some 15 shallow wells, 12 are producing from depths between 200 and 300 ft., with flows as high as 50,000 cu. ft. a day, production being mainly used by local industries. Northern Royalties 1, LSD 6, 35-29-32w1, the only deep test, is down 1,500 ft., about 360 ft. in the lime, and will be carried deeper for oil.

Turner Valley Lime Tests

North Turner Valley: Alberta Oil Incomes 2, LSD 4, 4-21-3w5, with 400-bbl. provisional allowable, flowed at the rate of 2,400 bbl. after acidization, and is making official test.

Home Oil 1, LSD 8, 33-20-3w5, got the Madison at 7,202 ft. and cemented at 7,225 ft.

Home 5, LSD 16, 28-20-3w5, is below 7,707 ft., 177 ft. in the lime.

Foothills Oil & Gas Co., LSD 13, 27-20-2w5, is below 7,452 ft., 274 ft. in the Madison.

West Central field: Okalta Oil 9, LSD 13, 18-19-2w5, finished at 7,971 ft., with provisional quota of 238 bbl., is testing after acidizing with 6,500 gal. Calmont-Northwest 2, LSD 5, finished at 7,956 ft., 473 ft. in the lime, and is testing.

Arrow Royalties 2, LSD 15, 13-19-3w5, finished at 8,353 ft., is flowing by heads before acidizing and looks like a big well. Twin Valley 1, LSD 9, finished at 8,184 ft., 458 ft. in the lime, is acidizing and testing.

Allied Royalties 1, LSD 16, 6-19-2w5, is below 7,253 ft. after getting the lime at 7,169 ft.

Southwest field: Pacific Petroleums 4, LSD 3, 32-18-2w5, has finished a fishing job and is deepening from 7,848 ft., 318 ft. in the lime.

Northwest-Hudson's Bay 4, LSD 14, 8-18-2w5, finished at 8,387 ft., has acidized both lime horizons, and is testing produc-

New Tests Starting

North Turner Valley: Major Oils 2, LSD 12, 4-21-3w5, location.

West Central field: Southwest Petroleum 5, LSD 2, 8-19-2w5, location.

Atlas Royalties 1, LSD 1, 24-19-3w5, spudded, below 80 ft.

Southwest field: Northwest-Hudson's Bay 5, LSD 10, 8-18-2w5, spudded, below 516 ft.

Grease Creek Abandoned

On the Grease Creek structure, west of Olds and 80 miles northwest of Calgary, the joint test of Grease Creek Petroleums and Imperial Oil in LSD 2, 13-29-7w5, has been abandoned at 7,017 ft. owing to a fishing job. No indication of faulting was encountered, and a second test will likely be started next spring.

Tests in the Foothills

Clearwater structure: Ram River Oils 2, 1-37-11w5, is in green limestone below 1,650 ft. Clear Oils 1, LSD 8, 2-35-10w5, resuming after running casing to 743 ft.

Moose dome: Dome Oil & Gas 1, LSD 4, 16-22-6w5, starting 600 ft. below the top of the Madison, is below 80 ft.

McColl-Frontenac 1, LSD 9, 6-23-6w5, has spudded.

Sheppard Creek: Alberta Pacific 1, LSD 6, 7-16-2w5, in hard lime below 5,862 ft.

Blood Indian Reserve: Northwest Co. 1 West, LSD 3, 20-5-23w4, is below 1,897 ft.

Steveville Field

Anglo-Canadian 2, LSD 4, 14-20-11w4, below 3,704 ft., 452 ft. in the lime.

Standard of British Columbia 2 Princess, LSD 3, 13-20-12w4, is in the lime below 3,291 ft.

Vermilion Field

In the Vermilion field, East Central Alberta, six wells were completed in October, and 10 additional tests are drilling or rigging. Vermilalta Frankview 2, LSD 4, 20-50-5w4, finished at 1,830 ft., flowing 30 to 50 bbl. a day. Franco-Battleview 3, LSD 13, 20-49-5w4, finished at 1,870 ft., is testing production. Western Drilling 1, LSD 1, 30-50-5w4, bottoming at 1,859 ft., is rigging pump. Richardson 1, LSD 14, 20-50-5w4, finished at 1,825 ft., rigging for pumping test. Alberta Southern 1, LSD 15, 20-50-5w4, drilling below 500 ft. Conestoga 1, LSD 2, 30-50-5w4, finished at 1,850 ft., has run casing to bottom. Franco-Dalton 1, LSD 12, 25-50-5w4, is deepening below 1,950 ft. Acme Oil & Gas 1, LSD 5, 20-50-6w4, is deepening below 1,820 ft., after a strong gas pocket in an upper horizon exhausted itself. Gas flowed for a while at the rate of around 9,000,000 cu. ft. a day. Franco-Hammers 1, LSD 16, 19-50-6w4, is starting.

Lloydminster Field

Lloydminster: Shaw Petroleums 2, LSD

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Department of the Interior, United States Land Office, Cheyenne, Wyoming. Notice is hereby given that a lease of the oil and gas deposits in lot 6 (NW¼ SW¼) and SW¼ SE¼ Sec. 6, T. 26 N., R. 89 W., 6th P.M., 81.64 acres, in the Wertz Dome (additional) oil and gas field, Wyoming, is offered to the responsible qualified bidder of the highest bonus per acre, the minimum bid to be $15.00 per acre, pursuant to the provisions of section 17 of the act of February 25, 1920 (41 Stat. 437), as amended, at the royalty rate scale in the lease form shown in circular 1386, at a sale to be held in the office of the Register of the district land office at Cheyenne, Wyoming, at 10:00 a.m. on December 18, 1940. The successful bidder will be required to deposit on the day of the sale a certified check on a solvent bank, or cash, for one-fifth of the bid, and file a showing of qualifications to receive the lease required by section 7 of General Land Office circular 1386. The remaining four-fifths of the bid, together with the annual rental in advance at the rate of $1.00 per acre, must be paid and a $5000 corporate surety bond must be furnished prior to the issuance of the lease. The successful bidder is required to subscribe to the unit plan of operation for the Wertz Dome field, as approved by the Secretary November 4, 1937. Bidders are warned against violation of the provisions of section 59 of the United States Criminal Code, approved March 4, 1909, prohibiting unlawful combination or intimidation of bidders. The right is reserved to reject any and all bids at the discretion of the Secretary of the Interior. Register.

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Wisconsin Motor Corporation
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10, 25-49-1w4, bottoming at 1,771 ft., ran 3-in. tubing and developed fair gas production. Shaw 3, LSD 5, 23-49-28w3, running casing 1,710 ft.

Ontario Completions

Chatham Township, Kent County: Union Gas 25, Lot 9, Concession 12, 325,000 cu. ft. gas, total depth 1,620 ft. Luke Smith 1, Lot 12-10, 5 bbl. at 410 ft.

Mosa Township, Middlesex County: Perdue Syndicate 1, Lot 13-2, dry at 2,000 ft.

South Dorchester Township, Elgin County: Dominion Natural Gas 1 Evert, Lot 21-9, dry at 1,210 ft.

Windham Township, Norfolk County: Walters Syndicate 2, McPherson, Lot 11-4, 275,000 cu. ft. gas.

Walpole Township, Haldimand County: Broadway Gas Syndicate, Lot 20-7, dry at 925 ft. Standard Gas Syndicate 1, Lot 15-1, gasser at 930 ft. Standard 2, Lot 20-8, gasser.

Malahide Township, Elgin County: Union Gas 58, Lot 17-5, 177,000 cu. ft. gas at 1,080 ft.

Grey County: Perdue Syndicate 1, Richard Currie, West Church sideroad, 8 miles southwest of Collingwood, gas in broken formation in Trenton limestone at 800 ft., making 35,000 cu. ft. a day. It may be deepened.

Orford Township, Kent County: Union Gas 1, near Clearville, structure test, has discontinued drilling.

De Clute field, Raleigh Township, Kent County: Union Gas 51, Lot 141, Talbot Road south, finishing a gasser below 1,400 ft.

MICHIGAN OPERATIONS

Best Producers of Week in Adams and Porter Fields

By OTTO C. PRESSPRICH

SAGINAW, Mich., Nov. 11.—Don Rayburn completed another prolific producer in the new Adams field of Arenac County, the 2 Yenior in Section 22 rating 1,680 bbl. a day initially after acid treatment. That completion highlighted the past week of Michigan oil activity, which resulted in 24 completions, 15 of them dry holes, including two tests for gas.

In addition to the Arenac well, eight other producers were reported from various fields, including one rating better than 500 bbl. a day in Midland's Porter field, a Walker field well good for 435 bbl. in Kent County, three smaller ones in Allegan, and others producing under 100 bbl. a day in Gladwin, Monroe and Van Buren counties. Total initial new potential was 3,130 bbl. a day.

Wildcatting continued at its extensive pace, but the approach of winter weather was expected to retard exploration and it was indicated that little more activity could be expected in the new Osceola-Clare oil sector being defined by Taggart Brothers.

Eighteen permits for drilling were issued last week by the state Conservation Department. The list included five for Allegan County, three for Isabella, two for Adams of Arenac, others to Barry, Berrien, Clare, Kent, Oceana, Ogemaw, Osceola and Saginaw counties.

A new depth mark has been reached in Michigan oil exploration, Gulf Refining Co. reporting drillers at near 7,000 ft. on the 1 Bateson test in Bay County. The old mark, 6,674 ft., was set in 1935. The deep test—its goal is 9,000 to 10,000 ft.—was started 13 weeks ago. The test originally was drilled last year to 4,459 ft. Late summer this year was spent cleaning the old hole and setting casings and drilling got into full swing on September 30. Around 6,700 ft. last week the test was in saline formation, a zone interspersed with salt, dolomite and hydrates.

MICHIGAN COMPLETIONS

Allegan County

Cheshire Township: Lakeland Oil Corp. 1 G. Woolf, NE SE NW 15-1n-14w, dry, T.D. 1,342 ft.

Lee Township: Voorhees Drilling Co. 1 Bisceglia, NW SW NW 27-1n-15w, dry, T.D. 1,397 ft.

Overisel Township: H. C. Nelson 1 James Koopman, NW SW SE 9-4n-14w, 100 bbl., naturally, T.D. 1,487 ft.

W. L. McClanahan 2 John Lubbers, SW SE NE 16-4n-14w, dry, T.D. 1,509 ft.

H. C. Williams et al 2 Vander Kolk, NW SW NE 21-4n-14w, dry, T.D. 1,698 ft.

A. E. Kopprasch, Tr. 1 Edward Klingenberg, NE SE NW 21-4n-14w, 25 bbl., acid, T.D. 1,571 ft.

James S. Brailey 1 Henrietta Maatman, NW NW NW 21-4n-14w, dry, T.D. 1,647 ft.

Salem Township: R. D. Malcolm, Tr. 1 Bond, NE SW NE 36-4n-13w, dry, T.D. 1,737 ft.

Trowbridge Township: H. L. Gentry Engineering Co. 1 Hiram Wilson, NW NW NE 29-1n-13w, 200 bbl., acid, T.D. 1,384 ft.

Arenac County

Adams Township: Don Rayburn 2 O. Yenior, NW SW NE 22-19n-3e, 1,680 bbl., acid, T.D. 2,881 ft.

Berrien County

Berrien Township: D. A. Matteson 1 W. M. Little, SW NE SW 9-6s-17w, dry, T.D. 747 ft.

Gladwin County

Beaverton Township: Whitehill & Drury 1 Frank Fessel, NE NE SW 36-17n-2w, dry, T.D. 4,023 ft.

Hay Township: Chapman Oil Co. 1 Gulf Refining Co., C S½ SW SW 23-18n-1e, dry, T.D. 3,700 ft.

Isabella County

Wise Township: Cities Service Oil Co. D-1 Gas Well Unit, communitized, SE NW NE 17-16n-3w, dry, T.D. 1,326 ft.

American Drilling Co. 1 John Smith, SE NW SW 21-16n-3w, 48 bbl., acid, T.D. 3,712 ft.

Kent County

Walker Township: Harry T. Hanover 2 McKay, NW SW SW 19-7n-12w, 435 bbl., acid, T.D. 1,922 ft.

Midland County

Porter Township: Pure Oil Co. 35 Mina Narmore, C N½ NW NW 15-13n-1w, 504 bbl., acid, T.D. 3,402 ft.

Monroe County

Dundee Township: Vanco Oil & Gas Co. 3 Henry Montry, SW NE SW 30-6s-6e, 75 bbl., shot, T.D. 2,203 ft.

Summerfield Township: O. H. Powell and F. E. Gilbreath 1 Cain, NW NE SW 31-6s-6e, dry, T.D. 2,151 ft.

Ottawa County

Tallmadge Township: Gordon Oil Co. & Bolger Oil Co. 3 Harm Daling, SE SW SE 14-7n-13w, dry, T.D. 1,898 ft.

Wright Township: West Michigan Consumers Co. 1 Richard Riemersma, C E½ 18-8n-13w, gas test, dry, T.D. 1,337 ft.

Van Buren County

Bloomingdale Township: Clapsaddle & Harris 1 Viley, SE NW NE 15-1s-14w, 70 bbl., acidized, T.D. 1,267 ft.

Clapsaddle & Harris 3 James Peavey, NW NE NE 15-1s-14w, dry, T.D. 1,282 ft.

Twin Drilling Co. 1 Adolph Blust, NE SW NE 15-1s-14w, dry, T.D. 1,299 ft.

Thickest Sand Section in Edge Well at Tinsley

By GEORGE WEBER

JACKSON, Miss., Nov. 11.—Southeast Tinsley again took prominence last week, with completion of a well in the thickest Woodruff sand section yet encountered in the field. The Union Producing Co. 4 Robinette, a southeast-edge test, penetrated 120 ft. of the sand section from 4,862-4,982 ft. and was completed for for 462 bbl. daily with small tubing and casing pressures. Heretofore, the well with thickest Woodruff oil-sand section was Union's 1 Herron, a west-edge test with 102 ft. of saturation.

Further development of the thick Woodruff section to the southeast appears limited, however, because of the failure of the Whigate 2 Robertson, located about 1 mile southeast of the Union 4 Robinette and across the major fault from the field proper. Much acreage remains undeveloped to the south, however, and Tinsley continues to show indications of increasing reserves.

Tinsley production continues above 15,000 bbl. daily, most going to Baton Rouge and some to Vicksburg to be refined. Some crude, estimated at 3,000 bbl. daily, is reported moving up river to a refinery at Louisville, Ky.

Wildcatting

Drilling in Mississippi is again on the upswing, with locations and active operations exceeding abandonments and completions. No development of importance occurred during the past week in wildcatting, but 22 active drilling rigs kept interest distributed throughout most of the state. The city of Jackson has staked a fee well within the city limits in an effort to augment the city gas field's production, rapidly depleted during the past year. The 1 fee, it is believed, may open a gas section in the field not now producing in the remainder of the field. The Jackson field has been reduced to secondary importance in Mississippi's gas supply with completion of a new line from the Monroe district of North Louisiana.

Leasing and new interest continues its trend to the east, with Alabama, Florida and Georgia sharing more in the play each week. Geophysical activity indicates this trend, as the number of crews operating in Mississippi has declined to about 30 and Alabama now has 10 parties active. Core drilling, a recent exploratory move on the part of three operators is gaining in use, with work in Montgomery, Scott, Covington and Jefferson Davis counties.

MISSISSIPPI COMPLETIONS

Tinsley—Yazoo County

Union 1 Childress, NE SE 24-10-3, 372 bbl., C.P. 200 lb., T.P. 150 lb., T.D. 4,950 ft., Woodruff sand.
Union 4 Robinette, SW NE 19-10-2, 462 bbl., C.P. 280 lb., T.P. 225 lb., T.D. 4,987 ft., Woodruff sand 4,862-4,982 ft.
Union 7 Stevens, SE NW 12-10-3, 426 bbl., pumping, T.D. 4,846 ft., P.B. 4,809 ft., 7-in. 4,840 ft., perf. 4,740-54 ft. and 4,760-70 ft., Woodruff sand 4,740-96 ft.
Union 17 Stevens, NW SE 12-10-3, pumping 429 bbl., top Woodruff sand 4,820 ft., T.D. 4,840 ft.

MISSISSIPPI DRILLING REPORT

Attala County

Jones & Crosby 1 Allen, SW SW 33-13-5e, set 5½-in. casing 4,086 ft., S.D.
Gulf 1 S. J. Peeler, NE SE 35-15n-9e, set 10¾-in. casing 780 ft.

Clarke County

Walsingham & Earles 1 School Land, SW NW NE 16-4n-15e, moving in material.

Grenada County

James Papadakis 1 Holcomb, SE NE 13-22-2e, drilling 718 ft.
Womble & Williams 1 Conn. Gen. Life Ins. Co., NW SE 28-23-5e, S.D., T.D. 1,620 ft. (corrected).

Jones County

T. N. Smith 1 Hollifield, NW SW NW 20-8n-12w, drilling 5,075 ft.

Kemper County

R. M. Crabb et al 1 Land, NW NE 12-10-14, drilling 1,617 ft.

Lee County

R. L. Shoemaker 1 Martin, SW SW NE 33-9s-6e, S.D. 950 ft.

Marshall County

C. B. Blosser 1 C. Stansback, SE SE 19-3s-4w, no report, last report drilling 540 ft.

Montgomery County

E. R. Henderson 1 Columbian Mutual Life Ins. Co., 36-21n-5e, S.D. 3,504 ft.

Prentiss County

Home Development Co. 1 Allen, SW NW SE 8-7s-9e, no report, last report drilling 2,191 ft.

Sharkey County

British American Oil Prod. Co. 1 Houston Est., N½ NE SW 23-11n-7w, fishing 3,570 ft.

Tishomingo County

Mellen & Gear 1 Wood, SE SE SE 21-4s-11e, S.D. 840 ft., show gas.

Warren County

W. O. Allen 1 Tom Henry, W½ SW 4-7n-4w, drilling 7,104 ft.
Barker & Brander 1 Parker, NW NW 17-14n-1e, moving in material.
Magnolia and Exchange 1 Paxton-Brown, NW NW 13-14n-4e, drilling 3,887 ft.

Winston County

Frame & Young 1 Chancellor, NE 9-13n-14e, spudding.

Yazoo County

Arcarea Reserve Co. 1 J. G. Holmes, SE SE 22-12n-1e, coring 5,418 ft.
Joe Dawson 1 J. L. Wilson, SE SE SW 30-12n-3e, rigging up.
R. J. Dean 1 Allgood, NE NW 10-11n-2w, moving in material.
Edward DeLoach 1 Wilburn, 6-12n-3w, drilling 5,713 ft.

Shifting Crude Stream

(Continued from Page 68)

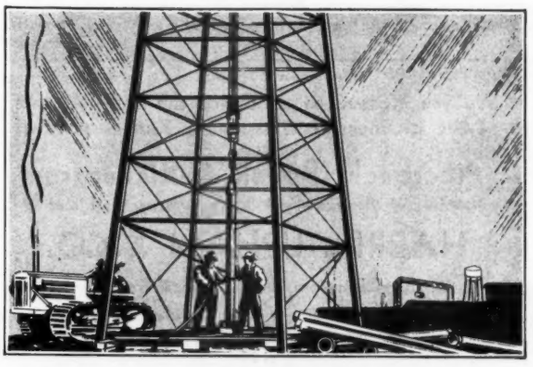
of its total yield during the first year of its life.

Thus has an important source of crude supply shifted within a generation from Illinois through a half dozen other states and back again to Illinois. And thus has history repeated itself in the records of these two areas of hectic oilfield development in Illinois, separated by the lapse of 30 years.

The early producers in Illinois acted no differently from their contemporaries in other states. Other great oil fields at that time were exploited in the same fashion, shortsighted as it appears in retrospect. The fact is that in those days the oil-producing industry knew no better than to produce its wells wide open.

But when, in 1937, opportunity knocked a second time at the door of the Illinois producer, methods of wide-open flow could no longer be excused by a plea of ignorance. In recent years a different policy has come to prevail in the production of oil.

Today, the flow of oil from wells is restrained in such manner as to prevent the escape of the natural gas dissolved in or associated with the oil. This procedure avoids the loss of reservoir



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energy—either the pressure of dissolved gas or the hydraulic pressure of edge or bottom water in the reservoir.

We have learned that oil in its natural reservoir underground is fluid in proportion to its content of dissolved gas. If this gas escapes, as it does in open-flow production, the oil left in the reservoir becomes viscous and no longer moves freely through the pore spaces of the same. In its changed state only part of the remaining oil can be recovered, and that part only with added difficulty and expense. The gas retained in solution in the oil through retarded flow serves to maintain the fluidity and so to increase the total oil recovery. The gas energy or pressure so conserved is utilized in lifting the oil to the surface. At the same time, the movement of water and gas through the sand is so controlled as to flush the oil out of the reservoir more completely.

Waste and Its Consequences

So well understood and so widely accepted are these principles that state conservation laws and the interstate compact of the oil-producing states alike are based fundamentally on the prevention of waste through retarding the rate of production.

It is no mere coincidence that this examination of a typical case of shifting sources of crude supply reveals also a case of wasteful methods of oil production. The two go naturally together. The rapidity with which the flow of the crude stream shifts depends in no small degree on how much waste is involved in the producing practices employed. In the face of the present decline rate there, it is obvious that Illinois cannot long continue to rank third, as it has recently, among the oil-producing states. Unless additional first-class discoveries are forthcoming promptly, this important source of crude supply must soon shift again from Illinois to some other state.

Through retarded flow as a conservation measure in crude-oil production, the shifting stream of oil can be made more dependable. In fields where conservation measures are most faithfully observed, permanence of supply is also most nearly attained. The degree to which permanence of supply has been approached in the best practice is not generally appreciated. Once visualized, the contrast between good practice and bad practice in this connection is startling.

Recently, Texas, California, Oklahoma, and Illinois have been our leading oil-producing states. Each of them has produced oil commercially over the past 30 years, or more. For each of them the ratio of mean annual production over the past 30 years to maximum annual production over that period becomes an index of dependability as a source of supply.

For Texas this ratio is 0.5; for California and Oklahoma each it is 0.7; and for Illinois, 0.1. These figures indicate that the Texas crude stream has shifted one-fifth as much, and the California and Oklahoma crude stream only one-seventh as much as in Illinois; or that Texas has been five times more dependable, California and Oklahoma each seven times more dependable than Illinois as a source of supply.

Stated differently, the comparison shows that Illinois has provided facilities for a peak flow 10 times greater than she needed for her average production, while Texas' facilities have been only twice her average requirements, Oklahoma's and California's only 30 per cent greater than their respective average requirements.

The Example of Salem

Representative of the oil fields in which conservation is enforced through the means of retarded flow are the East Texas field in Texas and the Kettleman Hills field in California. Each of these important fields is now a little more than 10 years old. The average annual production of the East Texas field over the past 10 years is 80 per cent of its maximum annual production. Its production for 1940 will be 70 per cent of its maximum, and more than 90 per cent of its average annual production over the past 10 years. The Kettleman Hills field also has an average annual production over the past 10 years equal to 80 per cent of its greatest year. Its 1940 production will be 60 per cent of its maximum annual production, and 73 per cent of its 10-year average.

Illinois' greatest field, Salem, can scarcely be expected to approach these records. If it is to produce in the tenth year of its life at even 60 per cent of its maximum rate (210,000 bbl. estimated daily average for 1940) it must be making 125,000 bbl. per day 7 years hence. But Salem production is already down to 140,000 bbl. daily, having declined more than 50 per cent from its peak of 290,000 bbl. daily within a period of 6 months. And the field is still only a little more than 2 years old!

Long before the Salem field is 10 years old, another important source of crude supply must have shifted in the well-established fashion to some other state. Meantime, Illinois will again have indulged in the extravagance of feverishly exploiting a series of great new oil fields only to have the resultant boom collapse at its peak. She will again have expended money and labor to provide producing, transporting, and refining equipment far in excess of any possible requirement of rational development procedure. She will again have exhausted the reservoir energy of prolific oil fields through wasteful open-flow producing methods, leaving behind in the pores of the sand, practically unrecoverable, much oil that, with retarded flow in keeping with modern conservation practice, might easily and cheaply have been brought to the surface.

Illinois, viewed as an oil-producing state, reveals the typical pattern of the shifting crude stream.

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Department of the Interior, United States Land Office, Buffalo, Wyoming. Notice is hereby given that the oil and gas deposits in the Black Mountain oil field, Wyoming, are offered for leasing to the bidder of the highest bonus per acre, pursuant to the provisions of section 17 of the leasing act of February 25, 1920 (41 Stat. 437), as amended, at the royalty rate scale in the lease form shown in Circular 1386, in the following units: *Unit No. 1*, T. 42 N., R. 90 W., Sec. 6, Lots 1 and 2; T. 43 N., R. 90 W., Sec. 31, Lots 10 and 11. *Unit No. 2*, T. 43 N., R. 90 W., Sec. 31, SW¼ NE¼, N½ SE¼. *Unit No. 3*, T. 43 N., R. 90 W., Sec. 31, Lots 5 and 6, E½ NW¼. *Unit No. 4*, T. 43 N., R. 90 W., Sec. 31, Lots 7, 8 and 9, NE¼ SW¼. *Unit No. 5*, T. 42 N., R. 90 W., Sec. 6, Lots 3 and 4; T. 42 N., R. 91 W., Sec. 1, Lots 1 and 2. *Unit No. 6*, T. 43 N., R. 91 W., Sec. 25, Lots 1, 2, 3, 4, N½ SW¼. *Unit No. 7*, T. 43 N., R. 91 W., Sec. 35, Lots 1 and 2. *Unit No. 8*, T. 43 N., R. 91 W., Sec. 35, Lots 3 and 4, NE¼ SW¼, NW¼ SE¼. Any two or more of the units listed may be consolidated in a single lease, provided the maximum acreage of such lease is not in excess of that permitted by law, the drilling, royalty and rental requirements to apply to each unit separately. The sale will be held in the office of the Register of the District Land Office in Buffalo, Wyoming at 10:00 o'clock, A.M., on November 20, 1940. The successful bidder will be required to deposit on the day of the sale a certified check on a solvent bank, or cash, for 1/5 of the bid, and file a showing of qualifications to receive a lease, required by section 7 of General Land Office Circular 1386. The remaining 4/5 of the amount bid, together with the annual rental in advance at the rate of $1 per acre, must be paid, and a $5000 corporate surety bond must be furnished prior to the issuance of the lease. The successful bidder of Unit No. 4 will also be required to reimburse the owner of the equipment in the well on the land for the reasonable value thereof, estimated at $12,292. The bidders are warned against violation of the provisions of section 59 of the United States Criminal Code approved March 4, 1909, prohibiting unlawful combination or intimidation of bidders. The right is reserved to reject any and all bids at the discretion of the Secretary of the Interior. Register.

LEGAL

Department of the Interior, United States Land Office, Las Cruces, New Mexico. Notice is hereby given that lots 3 and 4, NE¼ SW¼ Sec. 31, T. 25 S., R. 37 E., N.M.P.M., New Mexico, containing 119.86 acres in the Jal Field, New Mexico, are offered to the responsible qualified bidder of the highest bonus per acre for lease under section 17 of the act of February 25, 1920 (41 Stat. 437), as amended by the act of August 21, 1935 (49 Stat. 674), at the royalty rate scale in the lease form shown in Circular 1386 at a sale to be held in the United States Land Office, Las Cruces, New Mexico, at 10 o'clock, a.m., Dec. 4, 1940. The successful bidder must deposit on the date of the sale a certified check on a solvent bank, or cash, for 1/5 of the amount bid, and file the showing of qualifications to receive a lease, required by section 7 of Circular 1386. The remainder of the bonus bid and the annual rental of $1.00 per acre must be paid and a $5,000 corporate surety bond must be furnished prior to the issuance of the lease. The bidders are warned against violation of the provisions of Sec. 59 of the United States Criminal Code, approved March 4, 1909, prohibiting unlawful combination or intimidation of bidders. The right is reserved to reject any and all bids at the discretion of the Secretary of the Interior. Register.

LEGAL

Department of the Interior. Call for bids to purchase royalty oil accruing to the United States from the Salt Creek, Wyoming, oil field. Sealed proposals, in duplicate, will be received in the office of the Secretary of the Interior, Washington, D. C., on or before noon, November 15, 1940, from responsible bidders for the purchase, beginning January 1, 1941, of royalty oil accruing to the United States from Government lands in the Salt Creek, Wyoming, oil field. Detailed specifications on quantities offered for sale, required form of bids, deliveries, volume measurements, gravity determinations, bond requirements, and action on bids, should be obtained by prospective bidders from the Director, Geological Survey, United States Department of the Interior, Washington, D. C., the Supervisor, United States Geological Survey, Casper, Wyoming, or the Register, United States Land Office, Cheyenne, Wyoming. Sealed bids are to be submitted to the Secretary of the Interior, Washington, D. C., pursuant to the specifications, the envelope to be marked plainly "Bid on Salt Creek Royalty Oil —Not to be Opened Before Noon, November 15, 1940." No bid received after the time fixed herein for submitting bids will be considered. The right is reserved to reject all bids received pursuant to this advertisement whenever in the judgment of the Secretary of the Interior the interest of the United States demands. (Sgd.) A. J. Wirtz, Acting Secretary of the Interior.

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MARKET RECORD OF ACTIVE OIL STOCKS . . .

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New York Stock Exchange

1940 High	1940 Low	Week ended Nov. 9 High	Week ended Nov. 9 Low	Week ended Nov. 9 Close	Stocks—	Total shares outstanding	Par value	Latest dividend	Payable or last paid	Dividends paid in 1939	Com. sh. earn. 1939	Com. sh. earn. 1938	1939 High	1939 Low	1938 High	1938 Low
38½	38½	47	44	47	Amerada Corp.	788,675	N.P.	50cQ	10-31-40	$2.00	$1.56	$2.07	74½	50	78	55
27⅛	18¼	24¼	22½	24¼	Atlantic Refining	2,663,999	$25	25cQ	12-16-40	1.00	1.66	1.40	24¾	18⅛	27⅝	17⅝
16⅝	8½	11⅝	9⅝	11⅝	Barber Asphalt Co.	390,223	$10	25c	5-21-40	.25	1.39	—.85	21	10¼	23¾	12⅛
13⅜	7⅛	10⅝	9	10½	Barnsdall Oil Co.	2,558,779	$5	15c	12-9-40	.90	.76	1.26	19½	11⅛	21⅝	10⅛
8⅛	5½	6¼	5⅞	6¼	Consolidated Oil Corp.	13,751,726	N.P.	12½cQ	11-15-40	.80	.55	.55	9⅞	6½	10⅜	7
25	16½	20⅜	18¼	19⅞	Continental Oil of Delaware	4,682,572	$5	25cQ	9-30-40	1.00	1.35	1.10	31½	19⅞	35⅝	21¼
6⅞	3⅜	5	3¾	4¾	Houston Oil	1,098,618	$25	....	10-17-30	....	.43	.83	9⅝	4½	9¾	5
14⅜	9	10⅞	9⅞	10⅞	Lion Oil Refining	435,815	N.P.	25cQ	10-10-40	1.00	1.50	2.09	18⅛	10	25⅛	15⅝
17⅜	11½	14¼	13¼	14½	Mid-Continent Petroleum	1,857,912	$10	40c	12-2-40	.60	1.42	.56	18	11⅛	22⅝	12¼
11	7⅛	10	9⅛	10	Mission Corporation	1,378,645	$10	25c	12-20-40	.65	.87	1.04	14⅞	8¾	17¾	10⅝
9¾	4⅝	7⅝	6⅛	7⅜	National Supply	1,155,517	$10	....	12-22-37	....	—.87	—.79	15½	5⅝	23	12½
8¾	5⅜	7⅞	6¼	7¾	Ohio Oil Co.	6,563,377	N.P.	20c	6-15-40	....	—.10	.25	10½	6	14⅞	8¾
8¼	5½	7	6	7	Pacific Western Oil	1,000,000	N.P.	40c	12-19-39	.40	.81	1.22	11⅞	7	15⅞	10¼
10½	6¾	9¼	9¼	9¼	Pan American Pet. Trans.	4,702,945	$5	....	12-21-39	....	1.10	.08	8¾	5	9¼	6¾
41¾	29⅛	39¾	36	38½	Phillips Petroleum	4,449,052	N.P.	50cQ	11-30-40	2.00	2.21	2.03	46½	31¼	44⅜	27¼
22¾	15	17⅜	16	17	Plymouth Oil Co.	1,038,633	$5	35cQ	9-30-40	$1.40	2.38	2.59	24	17⅛	25⅜	15
11½	6¾	8½	7⅜	8½	Pure Oil Co.	3,982,031	N.P.	25c	12-20-39	.25	1.11	.38	11⅝	6⅛	13½	8¼
8⅜	5⅞	8⅛	7⅜	8⅛	Richfield Oil Corp.	4,010,000	N.P.	50c	12-18-39	.50	.65	.51	10¼	6⅝	9⅞	5
20	11	14½	13	14½	Seaboard Oil of Delaware	1,244,383	N.P.	25cQ	9-14-40	1.00	1.40	1.52	24⅜	15½	27½	15⅛
13⅛	7⅝	11	9¾	10⅝	Shell Union Oil	13,070,625	N.P.	25c	7-16-40	.50	.77	.72	17¼	9⅞	18⅜	10
23¼	12¼	22	20	21	Skelly Oil	995,349	$15	50c	12-20-40	.75	1.99	2.27	29½	15½	34¾	18⅛
12½	7⅛	9½	8¼	9½	Socony-Vacuum	31,206,071	$15	25cSA	9-16-40	.50	1.10	1.29	15⅛	10¼	16⅜	10⅝
26⅛	14¼	20⅛	18½	20	Standard Oil of California	13,003,953	N.P.	25cQ	9-16-40	1.10	1.38	2.22	33⅝	24¼	34⅞	25⅛
29	20¾	27⅝	26⅛	27½	Standard Oil (Indiana)	15,272,020	$25	50c†	9-16-40	1.25	2.23	1.82	30	22¾	35½	24⅝
46½	29⅞	36½	32¾	36⅜	Standard Oil of New Jersey	27,280,998	$25	75c†	12-16-40	1.25	3.26	2.86	53½	38	58⅜	39⅜
65⅞	46¾	51¾	50	51	Sun Oil	2,434,863	N.P.	25cQ	12-16-40	1.00	2.74	1.07	66	45¾	65⅛	45
2½	1⅛	1⅝	1⅜	1⅝	Superior Oil Corp.	1,388,979	$1	10c	12-28-38	....	.04	.24	3⅝	1⅜	4¼	1⅜
47⅝	33	40¼	36¼	39¼	Texas Corp.	10,876,139	$25	50cQ	10-1-40	2.00	3.02	2.13	50¾	32½	49⅝	32⅝
4¼	2½	3¼	3	3⅛	Texas Gulf Producing Co.	888,146	N.P.	10c	12-14-40	.20	.69	.86	5⅜	3¼	5⅞	2⅝
8⅝	5⅜	6⅜	5⅝	6⅜	Texas Pacific Coal & Oil	888,236	$10	10c	12-2-40	.40	1.00	1.16	11⅜	7	12½	7
12	8¾	10⅛	9½	10⅛	Tide Water Associated	6,371,827	$10	15c	12-2-40	.80	1.05	1.28	14¼	9½	15⅜	10⅛
17½	12	14	12½	13⅞	Union Oil Co. of California	4,666,270	$25	25c	11-10-40	1.05	1.25	1.47	19⅜	15⅛	22½	17⅛
29⅞	22¾	27½	26½	26½	Union Tank Car Co.	1,177,381	N.P.	45c	9-3-40	1.30	2.07	1.16	24¼	20⅛	23½	20
3⅝	1¾	2½	2	2	Wilcox Oil & Gas	470,768	$5	10c	2-15-40	....	.77	.52	4¼	2⅜	3½	1⅝

*Also 5 per cent in stock. †Includes extras. ‡Also 2 per cent in stock. §Also 4 per cent in stock. ‖Also 2½ per cent in stock. ¶Also 1½ per cent in stock. —Deficit.

New York Curb Exchange

1940 High	1940 Low	Week ended Nov. 9 High	Week ended Nov. 9 Low	Week ended Nov. 9 Close	Stocks—	Total shares outstanding	Par value	Latest dividend	Payable or last paid	Dividends paid in 1939	Com. sh. earn. 1939	Com. sh. earn. 1938	1939 High	1939 Low	1938 High	1938 Low
10¾	4½	6¾	4⅞	6¾	American Republics Corp.	1,308,049	$10	10c	7-11-38	....	$0.14	—.22	11¾	5½	11¾	5
3¼	1⅜	2⅝	2¼	2⅜	Bridgeport Machine Co.	263,700	N.P.	$1.25	12-30-37	....	—.95	—.14	7¼	2½	10¼	4¾
43	28	....	....	....	Buckeye Pipe Line Co.	200,000	$50	$1	12-14-40	$2.50	3.13	2.36	34¾	26½	38	22½
117	105	....	....	....	Chesebrough Mfg. Co.	120,000	$25	$1.50Q†	9-23-40	6.00	7.87	5.32	130	108⅝	128	97
6¾	4	6⅝	5¾	6⅜	Cities Service (new)	3,703,978	$10	....	6-1-32	....	.68	.23	9¼	4¼	11	5⅛
2⅛	‖	1	‖	‖	Cosden Petroleum	465,332	$1	....	.....	....	....	....	2¼	½	2⅜	⅞
24¼	11⅝	14⅜	12½	14½	Creole Petroleum	6,974,356	$5	50cSA†	12-16-40	1.00	1.38	1.64	28	16¾	27½	17½
4⅜	2⅞	4	3½	4	Darby Petroleum	351,390	$5	25cSA	1-15-39	.25	.03	.69	7½	3⅝	10¼	5½
2	1	1¼	1¼	1¼	Derby Oil & Refining	263,162	N.P.	....	.....	....	—.37	—.91	2⅝	1½	3½	1½
31	22	....	....	....	Eureka Pipe Line	50,000	$50	50c	11-1-40	2.00	.63	—.37	23	15½	31	16
39⅞	25½	32	30	31¾	Gulf Oil Corp.	9,076,202	$25	25cQ	10-1-40	2.00	1.69	1.43	45½	29¼	46⅞	33
68	47⅛	60⅝	57⅜	60	Humble Oil & Refining	8,987,840	N.P.	62½c	10-1-40	2.00	3.33	3.98	71	52½	72⅝	56
12⅜	5½	8	7¼	8	Imperial Oil of Canada	26,965,078	N.P.	37½c†	6-1-40	1.00	.71	.96	17	11⅜	19½	14⅛
7¾	3	3⅝	3½	3½	Indiana Pipe Line	300,000	$7.50	20c	11-15-40	.50	.33	.47	7¼	5½	9⅜	6
19¾	8¼	11¼	10	11¼	International Petroleum	14,324,088	N.P.	75c	6-1-40	1.75	1.19	1.98	27½	17	31¼	21
2¾	1⅝	..	..	..	Kirby Petroleum Co.	500,000	$1	10c	4-15-38	....	.06	.14	3¾	2⅛	5	2⅛
10¾	7⅝	10⅜	9¾	10⅛	Lone Star Gas	5,518,347	N.P.	30c	12-21-40	.70	.98	.88	10½	7⅛	10⅜	6⅝
6¼	3¾	4⅞	4¼	4⅞	Louisiana Land & Exp.	2,966,762	$1	10c	9-14-40	.35	.22	.45	7¾	4	9⅜	6½
17	9¼	10⅞	10⅞	10⅞	Margay Oil Corp.	149,943	N.P.	25cQ	10-10-40	1.00	1.52	2.28	17	14½	24	16
8½	6½	8¼	7¼	7¾	Midwest Oil Co.	998,474	$10	45c	12-16-40	.90	.99	.93	8¾	6⅝	9¾	6⅝
6¼	4⅞	6⅛	5¼	6⅛	Mountain Producers	1,593,584	$10	30cSA	6-15-40	.60	.70	.62	6	4⅞	5⅜	4½
13⅛	10	12	11⅜	11⅝	National Fuel Gas	3,810,183	N.P.	25cQ	10-15-40	1.00	.95	.84	14	11¼	14⅝	11½
12½	8¾	11	10¼	11	National Transit	509,000	$12.50	50c	6-15-40	.85	.91	.88	9½	7¼	9¼	6½
1¾	¾	1	1	1	New Mexico and Arizona	1,000,000	$1	1c	12-1-37	....	.02	.02	1¾	1	2⅝	1½
7⅜	5¼	6½	6½	6½	New York Transit	100,000	$5	25c	9-20-40	.40	.88	.16	6	4	4½	3½
9⅞	6	9	9	9	Northern Pipe Line	120,000	$10	40c	12-2-40	.30	.31	.24	7	4½	6	4
5½	2½	3½	2⅞	3½	Pantepec Oil	2,856,872	$1	....	.....	....	....	....	7⅝	4	7¾	3½
3⅜	1¼	3⅜	2⅞	3¼	Root Petroleum Co.	336,045	$1	25c	2-1-37	....	.70	.17	5	1¼	4½	1⅝
2½	1½	2½	2⅜	2½	Ryan Consolidated	298,931	N.P.	....	.....	....	.16	.29	3	1⅞	4	2⅛
11¾	4¾	....	....	....	Southern Pipe Line	100,000	$10	25c	9-3-40	.30	.25	—.27	4⅞	3½	5⅜	3¼
44	28	35½	35	35½	South Penn Oil	1,000,000	$25	37½c	9-27-40	3.00	2.84	1.44	40½	26¾	39	28¾
35	21	....	....	....	Southwest Penna. Pipe Lines	35,000	$50	50c	9-16-40	2.00	2.06	—.41	23	18	22¼	16½
20⅞	16½	19½	18⅞	19½	Standard Oil of Kentucky	2,604,790	$10	25c	9-14-40	1.30	1.53	1.45	20⅛	17¼	18¾	15
41¾	26¼	35	32½	35	Standard Oil of Ohio	753,740	$25	25c	9-14-40	1.50	6.64	1.81	32¾	17	22¾	16¼
2	1⅜	1⅝	1⅜	1½	Sunray Oil	1,975,876	$1	5c	5-1-40	.10	.25	.23	2¾	1¾	3¼	2
3⅛	2	2⅝	2⅝	2⅝	Texon Oil & Land	936,024	$2	10c	9-30-40	.10	.49	.56	4	2⅝	5¼	3½
3⅜	2	2⅜	2	2⅜	Transwestern Oil Co.	750,000	$10	....	.....	....	—1.42	.12	6	2½	5¼	2⅝
2⅛	‖	1¼	1⅛	1¼	United Gas Corp.	7,818,959	$1	....	.....	....	—.55	—.51	3⅝	1½	5¼	2⅝

†Includes extras. —Deficit.

Personal Paragraphs

EDWIN LEABOW, of Dominguez Oil Fields Co., with offices in the Union Oil Building, left Los Angeles, Calif., a few days ago for a brief visit in the East while attending the annual meeting of the A.P.I. in Chicago.

WALTER HELD, Standard Oil Co., and ROY LINDEN, Union Oil Co., have been named committee members of the Community Coordinating Committee, of San Francisco, Calif. This is one of many committees being formed in key cities in the nation to further the campaign of the National Association of Manufacturers to "mobilize for the understanding of free enterprise."

DELBERT H. CLARK and MAX JONES, both with the Blackwell Oil & Gas Co., Cushing, Okla., have been transferred to Pawhuska, Okla.

JACK C. JONES, of Pampa, Tex., has been named district foreman of the Humble Pipe Line Co., in the West Texas-New Mexico district, succeeding the late JIM GRIFFIN. He will be stationed at Odessa, Tex.

BILL SKEEN, Tyler, Tex., has purchased the Phoenix Gasoline Refinery in the Long Lake field, and he and his associates are expected to enlarge the plant for extended operations.

H. W. HAIGHT, manager of operations for Standard Oil Co. of Egypt, has returned to Cairo following a visit to several points in the United States. He flew back to Cairo via the lines serving the Pacific and Far East.

A. V. BOURQUE, former president of the Petroleum Sales Co., Tulsa, has formed his own company under the name A. V. Bourque, Inc., to do a general marketing business of petroleum and its products. The former company has been dissolved.

ISAAC J. WEST, who has been in the Abilene, Tex., office of Lewis Production Co., of Tulsa and Pittsburgh, Pa., has been made superintendent of the Illinois-Indiana division of the company and has been transferred to Mount Carmel, Ill.

DR. L. C. SNIDER, New York. N. Y., president of the American Association of Petroleum Geologists, was a guest of the Rocky Mountain Association of Petroleum Geologists at a luncheon in Denver, Colo., on November 6.

J. A. HARPER, geologic scout with Pure Oil Co., has been transferred from Wichita Falls, Tex., to Jackson, Miss. He replaces E. V. S. LOWERRE, who goes to Enid, Okla. The changes result from transfer of Mississippi from the Mid-Continent to the Texas division of the company.

C. H. THIGPEN, chief engineer, Arkansas Oil and Gas Commission, has returned to El Dorado after attending the first annual short course of the American Recycling Association, Kingsville, Tex. A. L. VITTER, chief physicist, Louisiana Department of Conservation, attended the same meeting.

F. M. BANKS, vice president of Southern California Gas Co., was awarded the Addison B. Day Medal of Honor by the Pacific Coast Gas Association at its last meeting, for outstanding work.

L. McKILLOP, of Hamilton, Ont., Canada, who for the past 10 years has been in charge of drilling operations for Oil Search, Ltd., and subsidiary companies (Australia), has accepted an appointment as field manager with the Papuan Apinaipi Petroleum Co., Ltd., of Sydney, and takes up his new duties at once.

ALLEN WHITESIDE, executive assistant to the president and a member of the board of directors of the Sinclair Prairie Oil Co., Tulsa, has resigned as of November 15. He will become executive director of the Fields Foundation of Tulsa, a national organization actively engaged in rehabilitation work among deserving former inmates of penal institutions.

C. E. BUCHNER, executive manager of the Independent Petroleum Association of America, addressed 100 producers and royalty owners at Gainesville, Tex., November 7. Mr. Buchner outlined the five-point program of the I.P.A.A. A committee comprised of S. W. SIMS, chairman, and JOHN GRAY, D. L. MONROE, F. E. CASE, and F. C. BLAGG, was in charge of the affair.

LLOYD REARDON, of Petrolia, Ont., Canada, has left to take a position with a producing and refining company in Trinidad, British West Indies.

N. C. McGOWEN, president of United Gas Pipe Line Co., is chairman of the annual Cub parents' pot-luck dinner to be given at Shreveport, La., December 10.

CAPT. H. D. EASTON, JR., independent operator of Amory, Miss., has been called to active duty in the U. S. Army, and will be stationed at Fort Sill, Okla.

WALTER WARD CLOPTON, pipeline superintendent in the Wichita Falls, Tex., district, United Gas Pipe Line Co., has been appointed district manager there.

NEAL LAU-BACH, lubricating-plant foreman at Ponca City, Okla., for Cities Service Oil Co., has been called to New York City for a special assignment at general headquarters for the parent concern. He expects to be away for 90 days.

U. B. BRAY, independent oil consultant, Los Angeles, Calif., and G. C. RICHARDSON, Indian Territory Illuminating Oil Co., Bartlesville, Okla., were session chairmen at the National Fuels and Lubricants meeting of the Society of Automotive Engineers at Tulsa last week.

RODNEY S. DURKEE, president of Lane-Wells Co., and who for several years was comptroller of General Petroleum Corp., was the principal speaker at a dinner concluding the second annual Accounting Institute at the University of Southern California a few days ago.

Do You Remember?

From The Oil and Gas Journal Files

25 YEARS AGO

The credit for discoveries of oil pools in Wyoming and Montana was due to the energies of the geologists, which goes to show that sometimes "geological dope," as it is contemptuously referred to by certain old-timers, is not infrequently right.

Drilling of a deep test in the Chanute, Kans., district to ascertain if it is possible to penetrate the Mississippi lime and whether oil underlies it, will be watched with interest, as this has been one of the moot questions for years in the Mid-Continent field.

20 YEARS AGO

Peru is to have laws enacted whereby petroleum restrictions will be more stringent in that country. After a short time the United States will be the only country in which free-for-all oil-seeking privileges will be available.

The hunt for oil in Nebraska is still on, with a test near Red Cloud drilling around 3,700 ft., but with few encouraging showings. Three or four other tests are being drilled elsewhere in the state.

William N. Davis, of Foster & Davis, Bartlesville, Okla., is new president of the Mid-Continent Oil and Gas Association, succeeding J. Edgar Pew, Sun Oil Co., Dallas, Tex.

10 YEARS AGO

E. B. Reeser, Barnsdall Corp., was reelected to a third term as president of the American Petroleum Institute at the eleventh annual convention in Chicago.

Extent of the Woodbine sand pool opened in East Texas by Joiner and others recently still is undetermined. The outlook for a large area was dimmed this week when a well a short distance southeast of the discovery was shut down at 3,600 ft. after finding only 1 ft. of saturated sand. Many geologists hold the opinion the area is too far east in the basin to bring forth much producton from Woodbine sand.

DON R. JOHNSON, formerly with Kingwood Oil Co. at Effingham, Ill., is now with Gulf Oil Corp. in the Tulsa office, acting as assistant to DR. R. S. KNAPPAN.

WALTER B. PYRON, executive vice president of Gulf Oil Corp., Houston, Tex., has been granted leave of absence to go into active training in his capacity of general in the Texas National Guard.

V. C. SCOTT, in the geological department of Texas Co., has been transferred from Tulsa to Mattoon, Ill. His position in the Tulsa office was filled by B. M. MILLER, who was transferred here from the company's Mattoon office.

WILLIAM HUTCHINSON, president of Sands Petroleum Corp., of New York, was a recent business visitor in the Mid-Continent area, where he inspected company properties. He conferred in Tulsa with N. P. WHALEY, general manager.

JOHN B. NICHLOS, Chickasha, Okla., independent operator and one of the more active oil men in the southwestern part of the state, has donated 64 town lots in a Chickasha subdivision to the Oklahoma College for Women. The land adjoins the campus.

R. H. HARGROVE, general manager; M. A. ABERNATHY, vice president, and B. M. NOWERY, vice president, United Gas Pipe Line Co., presided as chairmen at the company's annual 3-day operating meeting in Shreveport, La., last week. N. C. McGOWEN, president, addressed the group.

THEO A. MORGAN, conservation director of the Kansas Corporation Commission; E. De GOLYER, consulting geologist and economist of Dallas, Tex., and EARL FOSTER, counsel of the Oklahoma Corporation Commission, have been made chairmen of the regulatory practice, engineering and legal subcommittees, respectively, of the Interstate Oil Compact Commission.

It Can Happen Here

It happened to the Brothers Guinn.

The wildcatter's dream envisions the discovery of an oil pool. Now and then such dreams come true, but usually after many disappointments.

B. G. GUINN

But to dream that the very first wildcat drilled would be a producer, would open the first oil field in a state and that the second test would win a bonus—well, that's beyond the limits of probability.

Yet it happened to the Brothers Guinn!

Birl George Guinn was born in Healdton, Okla., May 31, 1901. His brother, William Alexander Guinn, dates his birth from October 3, 1894. They spend their boyhood in West Texas, Birl attending school at Slaton and William at Sweetwater, Tex. Their early life was prosaic as that of the average American boy.

Their connection with the oil business dates back to 1930, when they organized the Guinn Drilling Co. Eventually they decided to do some drilling on their own hook. About that time the now historic Forest City basin lease boom broke in all its fury. Lease and land men rushed into the Missouri, Iowa, and Kansas sectors of that basin, only a few paying attention to the Nebraska sector. Among those few were the Brothers Guinn. They became associated with A. L. Ladner, geologist and seismologist, and upon his recommendation and seismic work they staked location for their first wildcat well on their 80,000-acre block in Nebraska.

Their dream came true. They not only opened an oil pool, but it was the first discovery in the Forest City basin and the first in Nebraska. Eventually, they qualified for $15,000 bonus offered by Nebraska for the first oil well to produce for 60 consecutive days in the state.

Birl likes baseball and golf, but right now hasn't much time for either sport. He is the public contact man for the firm. William remains more in the background, looking after the details of their work. Both have families.

HAROLD I. FRY, of Socony-Vacuum Oil Co. at Caracas, Venezuela, and Mrs. Fry are visiting relatives at Oil City, Pa.

GEORGE ROSS, who has completed a course of study at the University of Minnesota, is now working in the engineering department of the Philgas Division of Phillips Petroleum Co. at Pontiac, Mich.

GEORGE R. PINKLEY, consulting geologist of San Antonio, Tex., discussed "Productive Prospects of Northern Alabama" at the weekly meeting of the South Texas Geological Society at San Antonio last week.

ALEX U. McCANDLESS, president of Mahutska Oil Co., and C. C. CARROLL, manager of the Illinois division of the Ohio Oil Co., will be chairmen of the oil and gas section of the program dedicating the Natural Resources Building on the University of Illinois campus at Urbana on November 16.

O. D. BRYAN, field gager for the Kansas Corporation Commission in charge of bottom-hole pressure tests, has adopted a method that assures promptness on his part in keeping appointments with operators in the field. He is said to donate $1 to the Red Cross for each hour he is late in reporting at a well.

CECIL HAGEN, consulting geologist, Houston, Tex., returned this week from Ecuador, South America, where for the past month he has been making a geological survey for oil potentialities. He made the trip by air, stopping for short periods in Mexico, and various places in Central and South America.

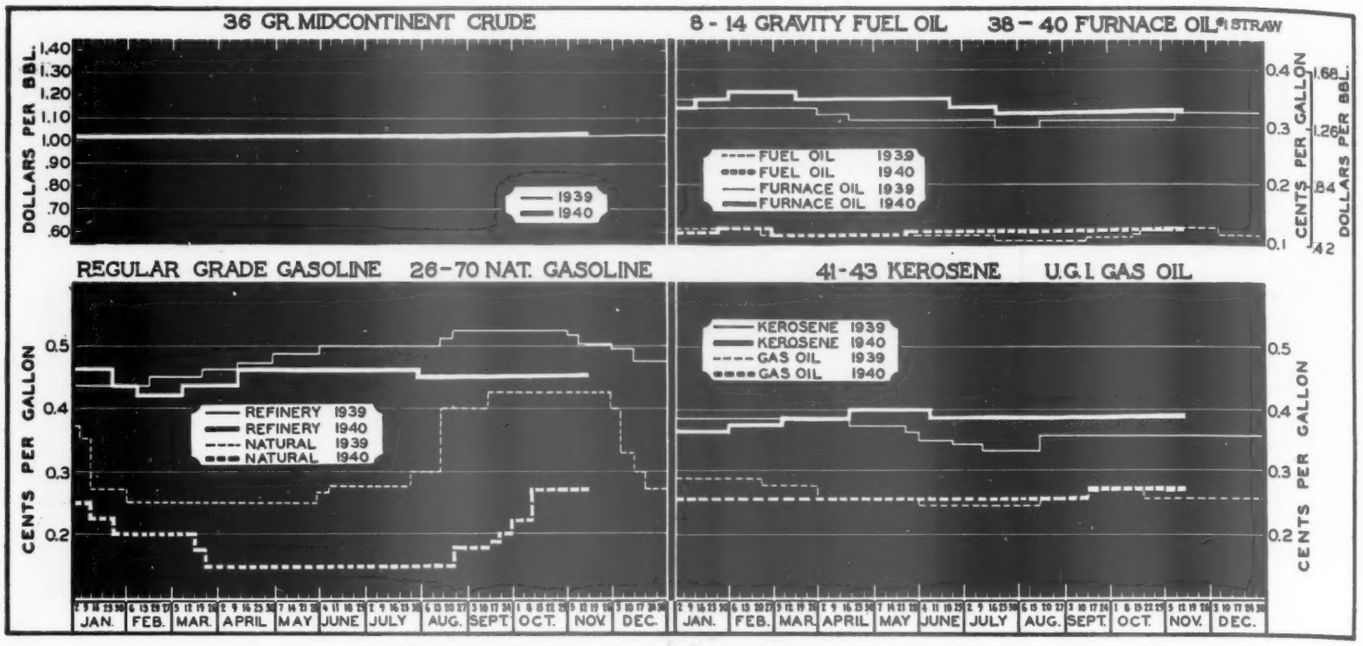
GEORGE GODDARD, of Bartlesville, Okla., manager of production for Cities Service Oil Co., suffered a heart attack en route to the A.P.I. convention at Chicago and was removed from the special train at Fort Madison, Iowa. CLYDE BRIDGES, chief engineer, accompanied Mr. Goddard to the hospital where he was reported seriously ill.

GEORGE ECHOLS, president of the Titanic Oil Co., Houston, Tex., is spending several days in coastal Louisiana watching the outcome of his company's wildcat in Jefferson Parish which is showing promise of opening a new field a few miles west of New Orleans.

Shifts: WILLIAM J. ROBERTS, engineer, Phillips Petroleum Co., from Vernon, Tex., to Fairfax, Okla.; C. H. McKENNON, superintendent, Hurricane Petroleum Corp., from Overton, Tex., to Beaumont, Tex.; R. H. VENABLE, superintendent, McClanahan and Venable Oil Co., from Tyler, Tex., to Dallas, Tex.; CHARLES T. CONRAD, engineer, Gulf Oil Corp., from Cotton Valley, La., to Tulsa; W. B. HOGG, engineer, National Geophysical Co., from Canton, Miss., to Magnolia, Ark.; WORTH B. HURT, geologist, Magnolia Petroleum Co., from Meridian, Miss., to Sulphur Springs, Tex.; FRANK C. ROPER, geologist, Roper & Todd, from Jackson, Miss., to Houston, Tex.; E. L. BIRMINGHAM, engineer, Margay Oil Corp., from Jackson, Miss., to Wichita, Kans.; R. L. WALES, engineer, Texas Co., from New Martinsville, W. Va., to Waynesburg, Pa.; WARREN H. WYNN, geologist, Sinclair Prairie Oil Co., from Wheeling, W. Va., to Tulsa; DOUGLAS CLARK, engineer, Stanolind Oil & Gas Co., from Loyd, Colo., to Denver, Colo.; A. J. ROGERS, geologist, Skelly Oil Co., from Falls City, Neb., to Tarkio, Mo.; P. T. AMSTUTZ, JR., engineer, Phillips Petroleum Co., from Bartlesville, Okla., to Great Bend, Kans.; J. F. BERRY, superintendent, Phillips Petroleum Co., from Oklahoma City, Okla., to Smackover, Ark.; V. C. SCOTT, geologist, Texas Co., from Tulsa, to Mattoon, Ill.; T. D. WALKLEY, superintendent, Oklahoma Pipe Line Co., from Viola, Wis., to Tulsa; B. M. NOWERY, vice president, Union Producing Co., from Houston, Tex., to Shreveport, La.

E. H. BLUM, vice president, Atlantic Refining Co., has been named head of the local arrangements committee for the 1941 meeting of the East Texas chapter of the Petroleum Division of the A.I.M.E., which will be held at Dallas, September 25-27, 1941. He will be assisted by R. H. McLEMORE, of Sun Oil Co., and CHARLES CARPENTER, of the Bureau of Mines.

E. E. De BACK, general superintenden of the Coast Recycling Corp., Corpus Christi, Tex., was named president of the newly organized American Recycling Association, which concluded its first convention at Kingsville the past week. DR. O. L. ROBERTS, director of research of the Atlantic Refining Co., at Philadelphia, Pa., was elected vice president, and R. L. PEURIFOY, head of the department of engineering at the Texas Agriculture and Industrial College at Kingsville, was elected secretary and treasurer.



Representative Mid-Continent Quotations on Crude Oil and Refined Products, Basis Oklahoma (Group 3)

Volume of Group 3 Gasoline Demand Brightens Prospects for Winter

By H. STANLEY NORMAN

CONFIDENCE that this winter will establish a new high for motor-fuel consumption is growing daily. Projection of market-demand ideas over the entire winter is just now gaining a firm following and is largely based on the calls for material within the past few days from buyers in the northern part of the country.

Until this week refiners were willing to discuss the relatively active immediate market but were at least conservative in viewing conditions over a longer range. The first week in which liquidation of gasoline stocks extended this year beyond the normal upturn generated mild optimism. The second winter week of abnormal demand further depleted the ranks of the pessimistic until now there are only a few dissenting opinions.

Prices Still Unsatisfactory

If refiners could visualize the price structure for products moving into step with consumption, it would be difficult to subdue optimism. The fact is, however, that motor-fuel prices are unsatisfactory and conditions hold little encouragement for improvement through the winter. The drab price outlook does not extend over fuel oils for there is new evidence seen in the market daily that all grades of burning material are headed for higher figures.

Delayed arrival of winter in the northern part of the country has retarded any general upswing in the fuel-oil market. The northeastern section of the country has had its first fuel-oil market improvement of the winter, an advance of 0.3 cent. Part of the elevated price in the northeastern states can be attributed to the boost in tanker rates, although actually the two developments go hand-in-hand.

If there is any slight change in the Group 3 motor-fuel market it is a turn toward the high side of current quotations. There is considerable low-octane motor fuel offered in the current market at 3⅝ cents but there appears to be more refiners holding out for 3.75 cents, the top of current quotations.

The volume of movement is surprisingly high and all marketing circles consistently raise this point as the feature of present conditions. The movement into Chicago and large consuming centers between Oklahoma and the Great Lakes is not up to summer caliber, but is substantially higher than prevailed a year ago and considerably above general expectations.

Abandonment of the subnormal crude-oil posting by Panhandle Refining Co. and adoption of the regular gravity table does not mean the improvement in product prices that it might imply. Panhandle reduced the North Texas crude price last July when the management declared that it could not longer pay more for its raw material than obtainable from products. Doubtless the local conditions have improved in the North Texas section but return to the regular gravity table was dictated by need of protecting supplies.

Crude May Rule Market

As conditions in the crude-oil market tighten it may logically follow that soft spots in the product prices will firm. It may follow, if producers and refiners continue restraint, that product prices can be improved even in winter. Elevation of gasoline prices in the off-consuming season would be contrary to normal expectancy, but so is the liquidation of motor-fuel stocks this late in the year.

Natural gasoline is not measuring up to October conditions. Movement to the Gulf Coast has tapered off considerably. Coast refiners are still hoping that major companies will close on inquiries which have been in the market for several days and unblock November coastwise movement. There is no indication, however, that the inquiries, which came into the Gulf Coast market in the latter part of October, will result in business. Meanwhile, the refineries on the Gulf have delayed shipping instructions on natural gasoline from the North Texas and North Louisiana districts, which has backed up stocks and turned the local markets there to the soft side. Oklahoma quotations for natural gasoline to northern buyers is unchanged at 2.75 cents. If the North Texas market of 2.5 cents for 26-70 natural declines there may be a sympathetic slump in parts of Oklahoma.

Refined Oil Market Barometer

The volume of gasoline movement this late in the season continues to be the feature of petroleum markets throughout the country. Fuel-oil sales are gradually attaining winter stature and prices are firming on the East Coast and in the Chicago territory, the two major consuming districts. Fuels are tightly held by most refiners.

MID-CONTINENT: Motor-fuel prices are steady. Volume of gasoline shipments seasonably high.

GULF COAST: Refiners are growing restless over lull in November coastwise demand.

CALIFORNIA: Natural-gasoline demand increasing and fractional price advance expected.

PENNSYLVANIA: Gasoline firm, fuel demand brisk, neutrals firm and bright stocks slightly improved.

CHICAGO: Gasoline market resisting pressure. All grades of fuel oil in strong position.

Eastern Refined Market Moves Up to Offset Tanker Advance

By J. P. O'DONNELL

NEW YORK, Nov. 12.—Rising tanker rates continued to be the dominant factor in the eastern refined-oil markets as virtually all products reflected additional strength in sympathy with the higher cost of transportation from the Gulf Coast sources of supply. Eight to nine-cent advances in tanker rates were made during the past week, immediately following even more pronounced gains in the previous week.

Rates in effect at the end of last week were 48 cents per barrel for gasoline, 51 cents for kerosene and 54 cents for No. 2 heating oil, advances of 8, 8½ and 9 cents respectively. In the past 2 weeks Gulf-to-north-of-Hatteras rates have advanced 18 cents on gasoline, 19 cents on kerosene and 20 cents on light fuel oil.

Comparative data on the upward trend of tanker rates since last summer's lows follow:

Date—	Gasoline	Kerosene	No. 2 fuel
Sept. 1	.18	.19	.20
Sept. 15	.18	.19	.20
Oct. 1	.21	.22	.23
Oct. 15	.25	.26	.27
Nov. 1	.40	.42½	.45
Nov. 9	.48	.51	.54

The latest advance in rates which boosted that of light fuel oil to 54 cents per barrel is attributed to the chartering of a tanker by a dealer who needed immediate delivery and was willing to pay higher rates for it. Another factor hitherto unrecognized that may have an important part in the rise of Gulf-to-north-of-Hatteras rates is the scarcity of tankers in the Venezuela or Aruba-to-north-of-Hatteras trade. Great Britain's requisitioning of foreign tankers, especially Norwegian, has reportedly reduced the number of bottoms available in this trade. Among the charters last week was one from Venezuela, the 4,922-ton Norwegian tanker Fenja, which will make two trips from Venezuela to a north-of-Hatteras port, the first in late November, on a rate basis of 30 cents per barrel for light crude. Another tanker was reported chartered from Aruba to north of Hatteras for late November loading at 32 cents per barrel later in the week. It was also a foreign boat. The first charter indicated a rise of 7 cents per barrel in this trade and an additional 2 cents was indicated by the second charter.

Four charters were reported in the Gulf-north-of-Hatteras trade. Chartering of a Mallory tanker for early December loading on the basis of 45½ cents for fuel oil and 40 cents for light crude not only registered a new high for dirty carriers but also indicated, by the time of loading, the tightness of the market. Other charters reported last week were the 5,020-ton Cities Service Empire, November loading, basis 38 cents, light crude; the 4,018-ton American Trader, prompt loading, basis gasoline, 48 cents; kerosene, 51 cents, and heating oil, 54 cents, and the 5,090-ton Swiftarrow, early December loading, basis light crude oil 40 cents and fuel oil, 45½ cents.

With the tanker rates continuing upward, all products including gasoline were reported firm in the eastern market. Despite the comparative lateness of the season, gasoline prices in main are holding at late summer levels. Factors accounting for this are the sustained demand and the maintenance of withdrawals from storage. As a result of steady withdrawals from storage the East Coast refining district now has less gallonage stocks on hand than at the corresponding time a year ago. On November 2, this year, total finished and unfinished gasoline stocks on the East Coast were 18,709,000 bbl. against 19,013,000 bbl. on November 4, 1939, a decrease of 300,000 bbl. In view of the unbalanced condition that existed at the beginning of the motor-fuel season, the present position of motor-fuel stocks in this area represents a worthwhile achievement. The effect of continued high demand and sustained withdrawals on the price of 72-74-octane gasoline at various points on the East Coast is shown in the following table:

Point—	Sept. 1	Nov. 1
Boston	5.50	5.25
New York	5.00	5.00
Philadelphia	5.50	5.25
Baltimore	5.50	5.50
Charleston	6.50	6.50

Another indication of the comparative firmness of the motor-fuel market was the announcement by Socony-Vacuum Oil Co., Inc., leading marketer in the New York and New England area, that, effective Wednesday, November 13, it would raise the price of Mobilgas at its bulk plants throughout New York and New England, except western New York, 0.2 cent per gallon. Some areas in which retail prices are now unsettled, such as metropolitan New York, will not be affected by the change.

The general increasing firmness was also extended to fuel oil and No. 2 heating oil was reported to have advanced to a range of 4.25 to 4.50 cents in tankcar lots. This is an increase of 0.15 cent on the low side. Demand for heating oil was reflected in withdrawals from storage for the first time in the last full week in October. Withdrawals were continued in the succeeding week when they dropped to 17,788,000 bbl., a decline of more than 100,000 bbl. Despite these reductions in stocks, however, the latter remain well above the level of a year ago.

Heavier fuel oils have been unaffected by the increased demand noted in other products and prices remain at the same levels that have been in effect for months. Bunker C fuel oil remains quoted at $1.25 per barrel by major suppliers and at $1.15 by smaller companies. Recurring reports of renewed activity in Bunker C fuel oil have yet to be transformed into better prices.

Pennsylvania lubricating oils, particularly heavy cylinder stocks, were also reported to be enjoying an improved domestic demand. Some grades of cylinder stocks have been advanced and, according

(Continued on Page 269)

Gulf Coast Markets

HOUSTON, Tex., Nov. 12.—The expected heavy winter-demand for fuel and burning oils still had not developed on the Gulf Coast the past week but suppliers continued to quote previous prices. Strengthening markets on the East Coast are removing serious threat of any major weakening in this area. Higher prices on the East Coast are partly induced by the increases in tanker rates that make necessary the wider margins between the Gulf and Atlantic Coast markets. Movement of fuels and burning oils during the week was routine.

There has been some increase in gas-oil stocks as a result of the slow demand. This was indicated in the latest report of the Gulf Coast Refiners Association which shows 1,536,490 bbl., of various grades of distillate fuel on hand November 1, as compared with 1,289,577 bbl. on October 15. The same report, however, shows a decrease in stocks of heavy fuels. Market observers state that in view of the prospective seasonal increase in consumption, stocks are not excessive, and some refiners point out they would like to have more material on hand.

The same report recorded a decrease of 274,682 bbl. in gasoline stocks during the period. Reporting companies had 2,483,029 bbl. of gasoline on hand November 1 as compared to 3,010,031 bbl. October 1.

Decreases in gasoline stocks reflect the heavy buying from independent refiners during the first part of October. The material purchased was

(Continued on Page 269)

A.P.I. Weekly Refinery Statistics

REFINERY FIGURES FOR WEEK ENDED NOVEMBER 9 ARE NOT AVAILABLE DUE TO GENERAL OBSERVANCE OF ARMISTICE DAY

Stocks of Crude Oil in the United States

(BUREAU OF MINES ESTIMATE)

Week ended November 2, 1940	263,820,000 barrels
Week ended October 26, 1940	262,746,000 barrels
Week ended November 4, 1939	230,994,000 barrels

Figures do not include stocks of heavy, unrefinable California crude.

RETAIL OIL MARKETS...

Tank-wagon and filling-station prices on gasoline and kerosene furnished by larger marketing firms

Prices as of November 12, 1940

Taxes

The gasoline quotations given in the following tables include the 1½-cent federal tax, as well as state, county, and city taxes. The gasoline is the regular or standard grade. In most areas lower grades and a premium grade also are available.

Standard Oil Co. (Indiana)

	Gasoline Tank wag.	Dlr.	Incl. tax	Kero. tank wag.
Chicago, Ill.	15.6	13.6	4.5	10.0
Decatur	14.6	13.1	4.5	9.5
Joliet	15.6	14.1	4.5	10.0
Peoria	15.6	13.2	4.5	10.0
Quincy	15.4	13.9	4.5	9.8
Davenport, Ia.	15.6	14.1	4.5	‡10.0
Des Moines	15.4	13.9	4.5	‡9.8
Mason City	15.8	14.3	4.5	‡10.2
Duluth, Minn.	16.4	14.9	4.5	10.8
Mankato	16.0	14.5	4.5	9.0
Minneapolis	16.0	14.2	4.5	10.4
LaCrosse, Wis.	17.0	15.5	5.5	10.4
Green Bay	17.4	15.9	5.5	10.3
Milwaukee	16.8	15.3	5.5	10.2
Detroit, Mich.	14.1	12.6	4.5	7.6
Grand Rapids	13.0	11.2	4.5	9.1
Saginaw	14.9	13.4	4.5	9.1
Evansville, Ind.	16.6	15.1	5.5	†9.8
Indianapolis	16.8	14.8	5.5	†10.0
South Bend	16.8	15.3	5.5	†10.0
Fargo, N. D.	18.2	16.7	5.5	11.6
Huron, S. D.	17.5	16.0	5.5	10.9
Kans. City, Mo.*	14.8	11.8	4.5	8.0
St. Louis*	15.2	13.2	4.5	9.0
St. Joseph	14.9	13.0	4.5	7.9
Wichita, Kans.	13.8	12.3	4.5	7.0

*State tax 2 cents, 1-cent city tax, and 1½-cent federal tax. †Does not include 4-cent state tax. ‡Does not include 3-cent state tax.

Exclusive of state general sales taxes.

Discounts to commercial consumers: On purchases per month off tank-wagon prices: 1,000 gal. or more, 1.5 cents off; minimum delivery 25 gal.

Stanolex Fuel Oil in Chicago

Effective Oct. 7, 1940, f.o.b. Chicago, tank-wagon prices: Standard heater oil, 1-99 gal., 8.75 cents; 100-149 gal., 7.75 cents; 150 gal. and over, 7.25 cents. Stanolex fuel oil No. 1, 1-99 gal., 8.5 cents; 100-149 gal., 7.5 cents; 150-399 gal., 7.25 cents; 400 gal. and over, 6.75 cents. Stanolex furnace oil, 1-99 gal., 8.5 cents; 100-149 gal., 7.5 cents; 150-399 gal., 7.25 cents; 400 gal. and over, 6.75 cents. Stanolex fuel oil A, 1-399 gal., 5.75 cents; 400-799 gal., 4.75 cents; 800 gal. and over, 4.5 cents. Stanolex fuel oil B, 1-399 gal., 5.75 cents; 400-799 gal., 4.75 cents; 800 gal. and over, 4.5 cents. Stanolex Bunker C fuel oil, 1-999 gal., 4.5 cents; 1,000 gal. and over, 3.5 cents.

Ohio

STANDARD OIL CO. OF OHIO

	Gasoline Cons'r tank wag.	Di-vided dlr.	Incl. tax	Kero. tank wag.
Ohio points	16.0	15.0	5.5	*9.0

*Includes state tax of 1 cent.

Atlantic Coast District

STANDARD OIL CO. OF NEW JERSEY

	Gasoline Cons'r tank car	Dlr. tank wag.	Incl. tax	Kero. tank wag.
Atlantic City	11.00	12.60	4.5	7.7
Newark	11.00	12.60	4.5	7.7
Annapolis, Md.	12.85	14.35	5.5	9.5
Baltimore	12.25	13.75	5.5	8.5
Cumberland	13.65	15.15	5.5	10.0
Washington, D.C.	10.50	12.00	3.5	9.5
Danville, Va.	14.45	16.95	6.5	11.0
Norfolk	13.25	15.75	6.5	10.5
Petersburg	13.55	16.05	6.5	11.2
Richmond	13.55	16.05	6.5	10.5
Roanoke	14.75	17.25	6.5	11.0
Charles'n, W. Va.	14.05	16.55	6.5	12.6
Parkersburg	13.35	15.85	6.5	11.2
Wheeling	14.35	16.85	6.5	11.8
Charlotte, N. C.	16.40	15.50	7.5	9.8
Hickory	16.95	18.45	7.5	10.3
Mt. Airy	16.80	18.30	7.5	10.2
Raleigh	16.15	16.00	7.5	9.5
Salisbury	16.45	15.00	7.5	9.9
Charleston, S. C.	14.25	16.75	7.5	9.25
Columbia	15.10	17.60	7.5	11.5
Spartanburg	15.80	18.30	7.5	12.2

Price basis to Essolene undivided dealers: Dealer tank-wagon price less 0.5 cent per gallon. Price basis to commercial consumers, effective March 8, 1937, in Maryland, District of Columbia, and in Arlington and Fairfax counties in Virginia; and March 12 in New Jersey: To contract accounts purchasing at least one full compartment at a time by hose connection, on yearly purchases: From 2,500 to 100,000 gal., consumer tank-wagon price at time and place of delivery; 100,000 gal. per year, consumer tank-car price plus 0.5 cent per gallon. Consumer tank-wagon price generally will be equivalent to dealer tank-wagon price less 0.5 cent per gallon.

Effective January 16, 1939, in North Carolina the commercial consumer schedule became as follows: Single deliveries of 50 gal. or more, consumer tank-wagon price. Single deliveries of less than 50 gal., 4 cents per gallon over consumer tank-wagon price. Generally the posted consumer tank-wagon price will be equivalent to the dealer price, less 0.5 cent per gallon. The above policy also applies in South Carolina, effective January 23, 1939.

Southern District

STANDARD OIL CO. (KENTUCKY)

	Gasoline Cons'r tank wag.	Net dlr.	Incl. tax	Kero. tank wag.
Atlanta, Ga.	14.0	14.0	7.5	8.0
Augusta	17.0	17.0	7.5	9.5
Macon	15.0	15.0	7.5	9.0
Savannah	15.5	15.5	7.5	9.0
Birmingham, Ala.	16.0	16.0	8.5	9.0
Mobile	15.5	15.5	9.5	8.0
Montgomery	18.5	18.5	9.5	10.0
Jackson, Miss.	16.0	16.0	7.5	9.0
Vicksburg	16.0	16.0	7.5	8.5
Jacksonville, Fla.	16.0	16.0	8.5	8.0
Miami	16.0	16.0	8.5	8.0
Pensacola	17.5	17.5	9.5	8.0
Tampa	16.0	16.0	8.5	8.0
Lexington, Ky.	15.5	15.5	6.5	9.0
Covington	13.5	13.5	6.5	9.0
Louisville	15.0	15.0	6.5	8.5
Paducah	14.0	14.0	6.5	8.5

Price basis to tank-wagon consumers, effective January 4, 1937, 3 cents per gallon below tank-wagon price.

Montgomery, Ala., has a county tax of 1 cent per gallon, and a city tax of 1 cent per gallon on gasoline, in addition to state tax, and 1 cent per gallon on kerosene. Mobile, Ala., has a city gasoline tax of 2 cents per gallon; Birmingham, Ala., has a city gasoline tax of 1 cent per gallon; Pensacola, Fla., has a city gasoline tax of 1 cent. All are included in the table.

Pennsylvania and Delaware

ATLANTIC REFINING CO.

	Gasoline Cons'r tank car	Dlr. tank wag.	Incl. tax	Kero. tank wag.
Philadelphia, Pa.	12.5	13.5	5.5	10.0
Pittsburgh	13.0	15.0	5.5	10.5
Allentown	13.0	14.5	5.5	10.5
Erie	12.5	15.0	5.5	10.0
*Scranton	11.9	12.4	5.5	10.5
Altoona	13.0	15.0	5.5	10.5
Dover, Del.	...	14.0	5.5	10.5
Wilmington	...	13.5	5.5	10.0

Price basis to undivided dealers, dealer tank-wagon price less 0.5 cent per gallon.

Discount on kerosene, 2 cents per gallon off tank-wagon price on tank-wagon deliveries of 25 gal. or more at one time.

*Voluntary discount of 1 cent allowed to dealers only.

Pacific Coast Territory

STANDARD OIL CO. OF CALIFORNIA

	Gasoline Tank truck	Serv. sta.	Incl. tax	Kero. tank wag.
San Francisco	16.5	17.5	4.5	11.5
Los Angeles	16.0	17.0	4.5	10.0
Fresno, Calif.	17.5	18.5	4.5	12.5
Phoenix, Ariz.	20.5	21.5	6.5	*17.5
Reno, Nev.	19.5	20.5	5.5	13.5
Portland, Ore.	19.0	20.0	6.5	13.5
Seattle, Wash.	19.0	20.0	6.5	13.5
Spokane	20.5	21.5	6.5	16.5
Tacoma	19.0	20.0	6.5	13.5

*Includes 5-cent state tax.

Discount to dealers: On gasoline, off tank-wagon price, to 100 per cent dealers, 3 cents. To commercial consumers: On tank-wagon price; on single deliveries of 40 gal. and over, advance quantity discount extended at time of delivery, 3 cents. Service-station schedule applies on single deliveries less than 40 gal. On kerosene in tank-car, transport-truck, and trailer delivery, 3 cents off tank-wagon price; plant deliveries to jobbers, 2.5 cents below tank wagon.

March 18, 1939, split dealer discount was canceled.

New York and New England

SOCONY-VACUUM OIL CO., INC.

	Gasoline Cons'r tank car	Dlr. tank wag.	Incl. tax	Kero. tank wag.
Albany	11.8	12.5	5.5	7.6
*Met. New York, Manhat., Bronx, Queens, Brklyn., Staten Island	11.9	12.0	5.5	7.9
Buffalo	12.4	13.4	5.5	7.7
Rochester	12.8	13.4	5.5	8.3
Syracuse	12.5	11.7	5.5	8.7
Portland, Me.	11.2	13.1	5.5	8.0
Manchester, N.H.	12.3	12.6	5.5	8.8
Burlington, Vt.	12.3	12.3	5.5	8.2
Boston, Mass.	10.2	11.1	4.5	8.0
Worcester	10.8	11.5	4.5	8.1
Hartford, Conn.	11.0	11.5	4.5	7.5
New Haven	10.7	11.1	4.5	7.3
Providence, R. I.	10.2	11.7	4.5	8.0

*Does not include 2 per cent city sales tax, which is calculated on basis of net retail price exclusive of state and federal taxes. Metropolitan New York prices are undivided dealer prices; others are split dealer.

Effective August 8, 1940, the company changed its commercial consumer policy in New York and New England to the following:

Full compartment deliveries: Accounts buying less than 20,000 gal. annually, 0.5 cent above the commercial-consumer price; accounts buying from 20,000 to 120,000 gal. annually, commercial-consumer price; accounts buying 120,000 gal. annually and above, 0.25 cent off consumer price. Split compartment deliveries: Delivery of less than a full compartment, 250 gal., commercial-consumer price plus 1 cent. Steel-barrel deliveries: Commercial price plus 3 cents.

Rocky Mountain District

CONTINENTAL OIL CO.

	Gasoline Tank wag.		Incl. tax	Kero. tank wag.
Denver, Colo.	14.5	...	5.5	10.5
Grand Junction	16.5	...	5.5	12.5
Pueblo	13.5	...	5.5	9.0
Casper, Wyo.	16.5	...	5.5	11.5
Cheyenne	14.5	...	5.5	11.0
Billings, Mont.	16.5	...	6.5	12.0
Butte	15.5	...	6.5	13.0
Great Falls	17.5	...	6.5	12.0
Helena	15.5	...	6.5	12.5
Salt Lake, Utah	16.0	...	5.5	14.0
Boise, Idaho	†18.6	...	6.5	16.0
Twin Falls	†19.6	...	6.5	16.5
Albu'que, N. M.	*16.0	...	7.0	9.5
Roswell	*14.0	...	7.0	8.0
Santa Fe	‡17.0	...	7.5	9.5

*Includes city tax of 0.5 cent. †Includes state tax of 1 mill. ‡Includes city tax of 1 cent.

Tank wagon represents price to consumers. Dealer represents price to dealers. If no dealer price is quoted, the tank-wagon price applies to all classes of trade.

Central South District

STANDARD OIL CO. OF LOUISIANA

	Gasoline Cons'r tank car	Dlr. tank wag.	Incl. tax	Kero. tank wag.
New Orleans, La.	14.25	16.75	8.5	†11.0
Baton Rouge	14.75	17.25	8.5	‡10.5
Alexandria	14.75	17.25	8.5	‡10.5
Lafayette	15.00	17.50	8.5	‡10.0
Lake Charles	14.75	17.25	8.5	‡10.0
Shreveport	14.00	16.50	8.5	10.0
Knoxville, Tenn.	18.00	20.00	8.5	12.5
Memphis	16.00	18.00	8.5	11.0
Chattanooga	17.50	17.35	8.5	12.0
Nashville	17.00	17.50	8.5	11.0
Bristol	18.25	18.75	8.5	12.6

Essolene at dealer price less 0.5 cent per gallon to undivided dealers.

†Includes 1-cent parish tax and 1-cent state tax. ‡Includes 1-cent state tax.

Price basis to commercial consumers: Effective May 15, 1937, deliveries of 50 gal. or more in one territory take posted consumer tank-wagon price. Accounts taking deliveries of less than 50 gal. at one time pay posted consumer tank-wagon price plus 4 cents per gallon. Generally, the posted consumer tank-wagon price will be equivalent to the dealer price less 0.5 cent per gallon. Kerosene prices include 1-cent state tax.

Effective February 24, 1939, the company reestablished in New Orleans the commercial consumer policy on motor fuel effective in the rest of the state.

Effective December 12, 1938, the company revised its commercial consumer policy on motor fuel in New Orleans, as follows: Single deliveries of less than 50 gal., consumer tank car plus 2 cents per gallon 50 to 199 gal., consumer tank car plus 1 cent per gallon; 200 gal. and over, consumer tank car plus 0.5 cent per gallon.

Oklahoma and Arkansas

CONTINENTAL OIL CO.

	Gasoline Tank wag.	Incl. tax	Kero. tank wag.
Texarkana, Ark.	13.5	5.5	6.0
Fort Smith	12.5	5.5	6.5
Little Rock	16.0	8.0	8.0
Muskogee, Okla.	13.5	5.5	7.0
Oklahoma City	11.5	5.5	6.5
Tulsa	12.5	5.5	6.0

Tank wagon represents price to consumers. If no dealer price is quoted, the tank-wagon price applies to all classes of trade.

Nebraska

STANDARD OIL CO. OF NEBRASKA

	Gasoline Tank wag.	Dlr.	Incl. tax	Kero. tank wag.
Omaha	17.4	15.9	6.5	9.5
McCook	17.0	14.4	6.5	9.0
Norfolk	17.5	15.4	6.5	9.9
North Platte	17.8	15.5	6.5	10.2
Scottsbluff	17.4	14.5	6.5	10.8

Discounts to commercial consumers for tank-wagon deliveries covered only by standard commercial consumers contract, effective January 1, 1935.

Texas

	Gasoline Tank wag.	Dlr.	Incl. tax	Kero. tank wag.
Dallas, Tex.	11.5	15.5	5.5	6.0
Fort Worth	11.5	15.5	5.5	7.0
Houston	12.0	16.0	5.5	8.0
San Antonio	12.5	17.0	5.5	8.0

Naphtha

STANDARD OIL CO. (INDIANA)

	Tank wagon*
Oleum spirits	16.2
V.M.&P. naphtha	16.5
Cleaners' naphtha	15.5
Stanisol	15.5

*Prices include 3-cent Illinois tax but not 1-cent federal tax nor 2 per cent retail occupational tax.

Prices f.o.b. Chicago. Each price subject to discount of 1 cent per gallon for 150-gal. lots if covered by contract.

Tank-Wagon Changes

Socony-Vacuum Oil Co., Inc., reduced the dealer-tank-wagon price of regular gasoline 0.3 cent per gallon November 5 at Albany, N. Y. The kerosene-tank-wagon price was advanced 0.2 cent per gallon at Syracuse, N. Y., October 23 and at Buffalo and Rochester, N. Y., on November 7.

Standard Oil Co. of New Jersey reduced the consumer tank-car price of gasoline 0.5 cent per gallon November 4 at Annapolis, Baltimore, and Cumberland, Md.; Washington, D. C.; Danville, Norfolk, Petersburg, Richmond and Roanoke, Va.; Charleston, Parkersburg and Wheeling, W. Va. Charlotte, Hickory, Mount Airy, Raleigh and Salisbury, N. C.; Charleston, Columbia and Spartanburg, S. C. The reduction of 0.5 cent per gallon in tank-wagon prices was applied at all the above points, excepting Annapolis, Baltimore and Cumberland, Md., and Washington, D. C. The reduction at Salisbury, N. C., was 1 cent to the tank-wagon trade.

Standard Oil Co. of Nebraska reduced the dealer price of regular gasoline 0.5 cent October 23 at Scottsbluff, Neb.

Standard Oil Co. of New Jersey reduced the dealer-tank-wagon price of gasoline 1 cent October 31 at Salisbury, N. C.

Standard Oil Co. (Indiana) advanced the tank-wagon price of regular gasoline 0.3 cent per gallon at Grand Rapids, Mich., November 4 and raised tank-wagon price on kerosene at the same point 0.1 cent November 3.

Standard Oil Co. of Louisiana advanced the dealer-tank-wagon price of regular gasoline 1 cent at Nashville,

(Continued on Page 269)

PRICES OF REFINED PRODUCTS...

All quotations f.o.b. plant in cars for interstate or export movement except as otherwise noted

Prices as of November 12, 1940

The quotations are exclusive of the federal excise taxes of 1 cent a gallon on gasoline and 4 cents a gallon on lubricating oils. Octane ratings in Middle West, Mid-Continent, and Southwest are based on A.S.T.M. method of testing.

Refinery Gasoline

OKLAHOMA (Group 3)—

U. S. Motor grades:		
72-74 octane (regular)	.04½	.04¾
63-66 octane	.04	.04¼
60 octane and below	.03½	.03¾
60-62 400 grades:		
72-74 octane (regular)	.04½	.04¾
63-66 octane	.04	.04¼
60 octane and below	.03½	.03¾

NORTH TEXAS—

U. S. Motor grades:		
72-74 octane (regular)	.04½	.04¾
63-66 octane	.04	.04¼
60 octane and below	.03½	.03⅞
60-62 400	.03½	.03⅞

NORTH LOUISIANA (Ark. and N. La. delivery)—

U. S. Motor grades:		
72-74 octane (regular)	.04¾	.05
63-66 octane	.04¼	.04½
60 octane and below	.03⅞	.04⅛

ARKANSAS (Ark. and N. La. del.)—

U. S. Motor grades:		
72-74 octane (regular)		.04¾
60 octane and below		.04

CHICAGO (Based on Group 3)—

U. S. Motor grades:		
72-74 octane (regular)	.04⅝	.04⅞
63-66 octane	.04¼	.04½
60 octane and below	.03⅞	.04⅛
60-62 400 grades:		
72-74 octane (regular)	.04⅝	.04⅞
63-66 octane	.04¼	.04½
60 octane and below	.03⅞	.04⅛

PENNSYLVANIA (inland refineries)—

74-76 octane (regular)		.06
72-74 octane		.05¾

CALIFORNIA (domestic movement)—

58-60 400, 65 oct. and higher	.05½	.07¼
54-58 U. S. Motor	.04½	.06¼

EAST COAST (domestic)—

U. S. Motor grades:		
New York (Bayonne)*	.05	.06½
Philadelphia	.05½	.07
Boston	.05¼	.05½
Baltimore	.05½	.07¼
Charleston, S. C.	.06½	.07

*All grades of gasoline ⅛ to ¼ cent less for barge shipments. New York Harbor prices are for New York and New England delivery. Prices for New Jersey delivery ¼ cent lower.

GULF COAST (domestic)—

U. S. Motor grades:		
72-74 octane		.04
70-72 octane	.03⅝	.04
68-70 octane	.03¾	.04
65-67 octane	.03⅝	.04

Natural Gasoline

OKLAHOMA (Group 3)—

Grade 26-70		.02¾
Grade 18-55		.03¼

NORTH TEXAS—

Grade 26-70		.02½
Grade 18-55		.03

CALIFORNIA—

75-85 375-390	.04½	.05¼

NORTH LOUISIANA (Ark. and N. La. delivery)—

Grade 26-70		.02½

Tractor Fuel

OKLAHOMA (Group 3)—

40-42 gr., 315-325 l.b.p., 110-flash, 540-550 e.p.	.03½	.03⅝
41-43 gr., 300-320 l.b.p., 110-125 flash, 500-520 e.p.	.03⅝	.03¾
46-48 gr., 210-230 l.b.p., 480-max., e.p.	.03⅞	.04

Kerosene

(All kerosene water white)

OKLAHOMA (Group 3)—

42-44	.03⅞	.04
41-43	.03⅝	.03⅞

NORTH TEXAS—

41-43	.03¾	.03⅞

NORTH LOUISIANA (Ark. and N. La. delivery)—

41-43	.03¾	.04

ARKANSAS (Ark. and N. La. del.)—

41-43		.04¼

PENNSYLVANIA (inland refineries)—

46	.04⅞	.05⅛
45	.04⅞	.05

CHICAGO (Based on Group 3)—

42-44	.04	.04¼
41-43	.03⅞	.04⅛

CALIFORNIA (Pac. Coast market)—

38-43 high burning test	.04½	.05½

NEW YORK (Bayonne, N. J.)—

41-43		.051

GULF COAST (domestic)*—

41-43		.04

*Barge price ⅛ cent lower.

Furnace Oil

OKLAHOMA (Group 3)—

Range oil	.03⅝	.03¾
No. 1 prime white, 38-42	.03½	.03⅝
No. 1 straw, 38-40	.03¼	.03⅜
No. 2 straw, 32-36	.03¼	.03⅜
No. 3 zero to 10, 28-32	.03⅛	.03¼

NORTH TEXAS—

No. 1 prime white, 38-42		.03½
No. 1 straw, 38-40		.03⅜

NORTH LOUISIANA (Ark. and N. La. delivery)—

No. 2, 32-36	.03	.03⅛

ARKANSAS (Ark. and N. La. del.)—

No. 2, 32-36	.03¼	.03½

CHICAGO (Based on Group 3)—

Range oil	.03⅝	.03¾
No. 1 prime white, 38-40	.03½	.03⅝
No. 2 straw, 32-36	.03⅜	.03½
No. 3, zero to 15, 28-32	.03¼	.03⅜

NEW YORK (Bayonne, N. J.)—

*No. 1		.051
*No. 2	.0425	.0450
*No. 4	.0425	.0450

*Barge deliveries ⅛ to ¼ cent under above tank-car price.

Gas Oil and Fuel Oil

(Gas oil per gal., fuel oil per bbl.)

OKLAHOMA (Group 3)—

U.G.I. gas oil, under 35	.02¾	.03
No. 5, low pour point, 18-22	.72½	.77½
No. 6, 15 and above, 8-14	.50	.55

NORTH TEXAS—

U.G.I. gas oil, under 35	.02⅝	.02¾
No. 5 low pour point, 18-22	.72½	.77½
No. 6, 15 and above, 8-14	.50	.55

NORTH LOUISIANA (Ark. and N. La. delivery)—

10-14 fuel oil, industrial		.70

CHICAGO (Based on Group 3)—

U.G.I. gas oil	.02¾	.03
No. 5, low pour point, 18-22	.75	.80
No. 5, 15 and above, 18-22	.60	.70
No. 6, low pour point, 10-16	.60	.70
No. 6, 15 and above, 10-16	.50	.55

PENNSYLVANIA (inland refineries)—

36-40		.04¼

CALIFORNIA—

Los Angeles:		
30-40 gas oil, per bbl.	1.10	1.25
24 plus diesel, per bbl.	1.10	1.25
24 plus diesel (bunkers)	1.20	1.35
12-16 (bunkers at tidewater)	.65	.75
10-16 (cargo lots)	.65	.75
12-17 (tank cars)	.50	.75
10-17 (high sulfur)	.45	.65
San Joaquin Valley:		
10-18 (tank cars)	.50	.70
24 plus diesel, per bbl.	1.10	1.25
San Francisco:		
24 plus diesel, per bbl.	1.35	1.40
24 plus diesel (bunkers)	1.40	1.50
10-16 (bunkers)	.75	.80

GULF COAST—

No. 2 fuel	.03¼	.03½
43-47 diesel	.03¼	.03½
48-52 diesel	.03½	.03⅝
53-57 diesel	.03⅝	.03⅞
58-and-above diesel	.03⅞	.04
Diesel bunkers		1.50
Bunker C (bulk cargoes)		.80
Bunker C (bunkers)		.80

NEW YORK (Bayonne, N. J.)—

27 plus, gas oil	.042	.046
28-30 diesel (lighterage 6¼c per bbl.)		1.70
28-30 diesel (tank cars)	.041	.045
Bunker C (to ocean-going ships in N. Y. Harbor	1.15	1.25
Industrial fuel (tank cars)		.04

Lighterage charge 5c bbl. additional.

Bright and Steam Refined

OKLAHOMA (Group 3)—

200-210 D, 10-25		.18
150-160 D, 0-10		.13½
150-160 D, 10-25		.13
100-110 D, 0-10		.13
100-110 D, 10-25		.12½
Steam refined:		
600 dark green (untreated)		.07

PENNSYLVANIA—

Bright Stocks (Pennsylvania Grade No. 8 color, 140-150 at 210, 545-550 flash):		
10 pour point		.14½
15 pour point		.13½
25 pour point	.12	.13
Steam refined:		
600	.07	.07½
650	.08	.08½
600 flash	.09	.09½
630 flash	.11	.12

Neutral Oil

(Vis. at 100° F. except Pennsylvania and color N.G.A.)

OKLAHOMA (Group 3)—

0-10 pour point:		
150-3		.08
180-3		.08½
200-3		.08½
250-3		.10
280-3		.10½
280-4		.10
300-3½		.11
350-3½		.11½
400-3½		.12
500-3½		.12½
600-3½		.13
100-2½ paraffin oil, 10-25		.05¼
10-25 pour point:		
200-3		.08
250-3		.09½
280-3		.10
280-4		.09½

GULF COAST—

Pale oils:		
100-3	.05¼	.05¼
200-3	.07¼	.07¼
300-3	.07½	.07¾
500-3½	.08¼	.08½
750-3½	.08⅝	.08¾
1,200-3½	.08¾	.08⅞
2,000-4		.09
3,000-4		.10½
Red oils:		
200-5-6	.06⅞	.07
300-5-6	.07¼	.07½
500-5-6	.08	.08¼
750	.08⅝	.08½
1,200-5-6	.08½	.08⅝

CALIFORNIA (moving to dom. market)

Pale oils:		
100-2½-3	.07¼	.08
200-2½-3	.07¼	.08
300-2½-3	.07¼	.08
400-3-4	.07½	.08
450-3-4	.07¼	.08
550-3-4	.09	.11
600-3-4	.09	.11
Red oils:		
200-4-5	.07¼	.08
300-5-6	.07¼	.08
350-5-6	.09¼	.11½
400-5-6	.09¼	.11½
450-5-6	.09¼	.11½
500-5-6	.09¼	.11½
600-5-6½	.09¼	.11½
700-6½ plus	.09¼	.11½
750-6½ plus	.09¼	.11½
900-6½ plus	.09¼	.11½

PENNSYLVANIA—

150 vis., at 70° F., 3 color, 400-405 flash:		
Zero pour point		.22½
10 pour point		.21½
15 pour point		.20½
25 pour point	.19	.20
200 vis., at 70° F., 3 color:		
Zero pour point		.24½
10 pour point		.23½
15 pour point		.22½
25 pour point	.21	.22

Wax and Petrolatum

(Prices per pound)

OKLAHOMA (Group 3)—

124-126 (A.m.p.) w.c. scale	.02½	.03

PENNSYLVANIA (inland refineries)—

122-124 (A.m.p.) w.c. scale	.02⅞	.03
124-126 (A.m.p.) w.c. scale	.02⅞	.03

NEW YORK—

Wax in bags fully refined:		
125-127 (A.m.p.) wax		.0560
128-130 (A.m.p.) wax	.0560	.0570
130-132 (A.m.p.) wax		.0585
133-135 (A.m.p.) wax		.0615
135-137 (A.m.p.) wax		.0640
Crude scale:		
124-126 (A.m.p.) w.s.	.02⅞	.03
124-126 (A.m.p.) y.s.	.02⅞	.03
Petrolatum in barrels, carload lots:		
Dark green	.02125	.02625
Amber	.02375	.02875
Extra amber	.02625	.03000
Lily white	.04375	.05125
Snow white	.05125	.06000
Cream	.03375	.04125

Export Prices

GASOLINE

GULF COAST—

U. S. Motor		.03⅝
60-62 400		.03⅝
61-63 390	.03⅞	.04
64-66 375	.03⅞	.04

LOS ANGELES—

U. S. Motor grades:		
Above 69 octane	.05½	.05¾
65-69 octane	.05¼	.05½
60-65 octane	.04½	.05

KEROSENE

GULF COAST—

41-43 water white	.04	.04⅛

LOS ANGELES—

41-43 water white	.05	.05¼

LUBRICANTS

(Pennsylvania Grade)

NEW YORK (f.a.s. in bbl.)—

Cylinder stocks:	
600 S.R. unfiltered	.16
630 S.R. unfiltered	.17
600 flash, S.R.	.18
650 flash, S.R.	.20
Bright stock:	
Light, 25 pour point	.20½

NEUTRAL OIL

200-3 color	.27
150-3 color	.25½

PARAFFIN WAX

NEW YORK (prices per lb.)—

123-125 A.m.p.		.05600
125-127 A.m.p.		.05600
128-130 A.m.p.		.05850
133-135 A.m.p.		.06150
135-137 A.m.p.		.06400
Crude scale:		
124-126 w.s.	.02⅞	.03
124-126 y.s.	.02⅞	.03

EQUIPMENT PROGRESS...

New Buda Hydraulic Two-Speed Jack

The Buda Co., Harvey, Ill., announces the manufacture of a new model 25H10 hydraulic two-speed journal jack.

As shown by the illustration, it is a compact, dependable hydraulic jack for work where raising and lowering operations must be under complete control

at all times. It is ideal for working in limited spaces, especially desirable for removing railroad-car journals. In connection with its moving railroad-car journals, it is very fast—doing the same work in one-half the time as with mechanical jacks. The capacity of the jack is 25 tons with a 6-in. rise. The height of the jack closed is 10 in.; weight 45 lb.

The principal features of this jack are as follows: (1) Completely hydraulic, assures complete control of load at all times. Safe and easy to operate. (2) Two speeds, fast speed for medium and light loads, second speed for heavy loads. (3) Positive stop at limit of rise, impossible for ram to bind in cylinder at limit of rise. (4) Rugged construction, ram is made of solid bar stock. Base is high-strength malleable iron. (5) Swivel handle, provides for ease in carrying.

International Cementers, Inc., Organized

International Cementers, Inc., has purchased the physical assets of Pacific Cementing Co., as of November 1, 1940, and will continue to operate in California under the same management and with the same personnel as a nucleus for expanding operations both in the United States and foreign countries. International Cementers, Inc., has also taken over Dowell acidizing operations in California, which will be combined with the acidizing units formerly owned and operated by the Pacific Cementing Co.

The vice president and general manager of International Cementers, Inc., R. M. Cook, has assumed the management of the new company, and R. Henquet, executive vice president, will maintain his headquarters in the Los Angeles office of the company.

International Cementers, Inc., a Delaware corporation, was formed by Baker Oil Tools, Inc., Byron Jackson Co., Dowell, Inc., and Schlumberger Well Surveying Corp., and is to have its corporate headquarters at Houston, Tex. Directors of the company are: A. P. Beutel, N. R. Crawford, and C. Penhaligen, of Dowell, Inc.; E. G. Leonardon, R. Henquet, and P. Charrin, of Schlumberger Well Surveying Corp.; Frank Champion, of Byron Jackson Co.; and T. Sutter, of Baker Oil Tools, Inc.

Officers of the new company are: E. G. Leonardon, president; R. Henquet, executive vice president; R. M. Cook, vice president and general manager; N. R. Crawford, vice president; A. P. Beutel, treasurer; P. Charrin, secretary and assistant treasurer; and C. E. Whitney, auditor.

BUSINESS NOTES

Wheeling Steel Corp has announced the appointment of Harvey L. Miller as manager of a new district office at Houston, Tex., located at 2508 and 2509 Gulf Building, that city. Mr. Miller is well known to the steel trade in Texas due to many years of experience as representative for other manufacturers. Wheeling Steel announced at the same time that I. G. Thompson continues as district sales manager at Dallas, Tex.

Larkin Packer Co., Inc., announces the recent appointment of the W-K-M Co., Inc., as export representative, with offices located at 74 Trinity Place, New York, under the direction of G. M. Stewart.

C. L. McMullen has joined the staff of the Buda Co., of Harvey, Ill. (Chicago suburb), in an executive sales capacity, it was announced by R. K. Mangan, executive vice president of Buda. Mr. McMullen went to Chicago from Madison, Wis., where he was vice president of the Gisholt Machine Co. Before that, he was associated with Caterpillar Tractor Co. at Peoria, Ill.

H. H. Timken, Jr., Succeeds Father

Henry H. Timken, Jr., has been named chairman of the board of the Timken Roller Bearing Co., it has been announced. He will succeed his father, the late Henry H. Timken, Sr., in this capacity and will continue as vice president and general manager of the steel and tube division of the Timken Roller Bearing Co. Mr. Timken has been associated with the company since his graduation from Harvard and has been a director for 10 years.

John E. Fick, superintendent of the steel mill, has been added to the board. He has been affiliated with the Timken company for more than 20 years.

Graf Appointed Assistant Manager of Sales

Earl N. Graf, former manager of the Pittsburgh branch of the John A. Roebling's Sons Co. has been appointed assistant manager of sales, Wire Rope Division, with headquarters at Trenton.

Mr. Graf, who was born in Pittsburgh in 1893, gained his first business experience with the Carnegie Steel Corp., after having spent 3 years studying metallurgy and chemistry at the Carnegie Institute of Technology. He later became connected with the Midvale Cambria Steel Corp. (now Bethlehem Steel Co.) in general sales work, and then, in 1918, he opened a branch in Philadelphia, Pa., for the Beaver Refining Co.

His first association with the Roebling company came indirectly in 1919 when he took over specialized wire-rope sales for the Frick and Lindsay Co., a Roebling distributor in Pittsburgh. Frick and Lindsay later became the Frick-Reid Supply Corp. and Mr. Graf remained as the wire-rope specialist with the new concern.

In July 1938 Roebling opened a branch office in Pittsburgh and Mr. Graf was put in charge of wire-rope sales and in 1939 became manager of the branch, where he remained until his recent promotion.

Bulletin on Floor Furnaces

John Zink Co., 4401 South Peoria Avenue, Tulsa, manufacturer of gas burners, oil burners, and combination of oil and gas burners for the petroleum industry, announces the distribution of a new eight-page booklet covering John Zink floor furnaces. This floor furnace is available in three sizes with capacities of 25,000 B.t.u. per hour, 50,000 B.t.u. per hour, and 68,000 B.t.u. per hour. The burner used in these floor furnaces will operate on natural gas or butane.

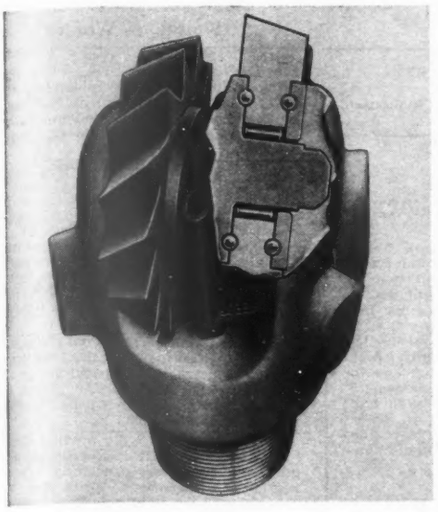
NEW PLANT OF UNIT RIG IN OPERATION

The new plant of the Unit Rig & Equipment Co., at Tulsa is now in operation. Growth of the company has been steady and employment has been greatly increased. No expense has been spared to bring the equipment and facilities up to the highest standard of efficiency, enabling the company to employ 200 or more men as production requires.

Manufacture and assembly of the popular Model U-10 Unit rig and other oil-field equipment has been stepped up with improvements in machinery and full use of over 40,000 sq. ft. of floor space under one roof. It is anticipated that ground will be broken soon for the construction of a completely new office structure to properly house the executive staff, as well as the engineering, purchasing, and accounting departments. Location of the new plant property is the entire block between Denver and Elwood on Archer Street in Tulsa's downtown industrial area.

Grant Oil Tool Introduces New Shale Drilling Bit

With the well-recognized fact that only a small percentage of actual drilling formations encountered is rock-bit digging, the Grant Oil Tool Co., 2042 East Vernon Avenue, Los Angeles, Calif., is introducing its new roller-cutter shale bit. This new bit utilizes a cut-



ting effect rather than the grinding method used in the ordinary rock bit, with a resulting increase in drilling speed and reduction in drilling costs.

It is declared that one of the outstanding features of this new bit is that it is the first cone bit to take full advantage of the hydraulic principle. This is done by having two center flow beans extend to the bottom of the bit, thus allowing circulation to strike the bottom of the hole without any interference. In addition the circulation is also directed over each cutter.

Another outstanding feature is the design which provides a maximum safety element making it next to impossible to lose a cutter or any other working part. This is accomplished because of the unusual ruggedness of the trunion assembly and unusually large bearing surfaces. The trunion is an eccentric type of one-piece construction which supports both cutters from leg to leg. Streamlining in design avoids excessive friction and allows maximum flow of returns.

Cutters are extra large and properly hard-faced for long wear, and are designed to utilize both roller bearings for thrust and ball bearings to take the radial pressure, thus providing ample strength under the hardest going. Specially designed cutters are available for each type of shale formation. Dull cutter assemblies are easily removed and replaced by new assemblies.

Link-Belt "Friction Fighter" Bearing Fight Is On!

Realizing the difficulties encountered in trying to distinguish between the series numbers assigned to the various types of antifriction bearing units, Link-Belt

Co., Indianapolis, Ind., is humanizing the presentation of its five types by comparing them with prize fighters and reclassifying the group according to the various weights of fighters known to the ring. The five different types are: Series 100 ball bearings, and Series 400, 500, 600, and 7200 self-aligning roller bearings.

The new classifications decided upon are: Flyweight for the Series 100; welterweight, Series 400; middleweight, Series 500; heavyweight, Series 600; and alternate heavyweight, Series 7200. The whole line of these bearings will be known as Link-Belt "friction fighter" bearings, since the term friction fighter so aptly describes a characteristic of the antifriction bearing.

To obtain more detailed information on Link-Belt's friction fighter bearing units—descriptive matter, illustrations, dimensions, list prices, weights, engineering data—readers interested in the use of such bearings should send for a copy of a new 88-page data book No. 1775, giving all this information and classifying the five types of bearings as hereinbefore indicated. The book is free for the asking, and the request may be addressed to the nearest office of the company.

MacLean Elected Vice President of Pittsburgh Equitable Meter

Colonel W. F. Rockwell, president of the Pittsburgh Equitable Meter Co., has announced the election of A. D. MacLean to the vice presidency of the company.

A. D. MacLean

Mr. MacLean is a graduate of the school of engineering, Harvard University. Immediately upon receiving his degree, he enlisted in the Army Air Service Corps, serving therein until the Armistice in the World War. His first connection in industry was with the Ashton Valve Co. of Cambridge, Mass., as chief draftsman. He later accepted a position with the engineering department of the new Departure Division of General Motors Corp. and was subsequently promoted to become assistant chief engineer.

In 1926 Mr. MacLean joined the EMCO organization as chief engineer, which position he has filled until the present date. Mr. MacLean is well known in industry as an author and lecturer on technical subjects.

New Brown Unit Protects Against Flame Failures

The Brown Instrument Co., a division of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa., announces a safe and reliable method of protection against failure of oil, powdered coal, and luminous gas flames by the recently developed Brown Protectoglo, photo-electrode system. The photo-electric principle used in the new unit avoids the necessity of placing a metallic electrode in the high temperature flames, but retains the quick response feature which is characteristic of thermionic systems.

The function and operation of the photo-electrode is quite similar to the familiar Brown flame-electrode Protectoglo system. The principle difference lies in its method of flame detection. Instead of using a metallic electrode, the Brown Protectoglo, photo-electrode system detects the presence of a flame by means of light emitted when a burner is in normal operation.

The heart of the system is essentially a light-sensitive device. In operation, the light from the flame is directed upon a photo cell. This results in a small flow of current through the cell which is amplified by a vacuum tube circuit until of sufficient magnitude to close a relay. Through the relay contacts, the main fuel valve is energized. The response of the system to flames of different luminosity may be changed on the job by means of a sensitivity adjustment. With this adjustment in the maximum position, the unit will easily respond to the light of a candle, while at the other extreme, with the adjustment at the minimum position, no amount of light will close the relay.

To prevent transient flame disturbances from causing unnecessary shut downs, the system has been designed to provide a time lag in the relay operation. This time lag is provided by the discharge of a small capacitor at the right of the sensitivity adjustment.

WELL EQUIPMENT CELEBRATES SIXTH ANNIVERSARY

Well Equipment Manufacturing Co., Houston, Tex., in observance of its sixth anniversary recently, celebrated with a banquet and dance at Golfcrest Country Club, Houston, as guests of C. K. Stillwagon, president. The annual sales conference of the company was also held in conjunction with the anniversary, with representatives from districts throughout the country in attendance. Coincidental with the company's sixth anniversary a sizeable expansion program in the office building and plant was completed, giving the organization more than 11,000 sq. ft. of floor space.

Refractories Booklet Issued

"World-Wide Refractories Service" is the title of a 40-page booklet issued by General Refractories Co., Philadelphia, Pa. This book is printed in both English and Spanish. It covers all the major types of refractories and their uses and includes 10 pages of tables of sizes, weights, volumes and general data as are usually required in the use, application and purchase of refractories.

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Leases and Drilling Blocks

LEASES—East Texas, La., South Ark. 20 acres up, dollar acre up.—Owners—Address Attorney, Box 1122, Little Rock, Ark.

SPECIALIZED Geophysical investigations conducted for petroleum promise. In touch with many opportunities to and for development of drilling blocks. P. O. Box 364, Fort Worth, Texas.

FOR SALE Oil and gas leases and small production located in Kentucky shallow field, also tracts of proven Fluorspar and zinc deposits. Reports on request. W. P. HARLEY, Bowling Green, Kentucky.

NEW MEXICO
Oil and Gas Leases and Royalties.
ROY G. BARTON, Hobbs, N. M.

EAST TEXAS Trinity sand wildcat starting. Close in leases afford you ten to fifty for one bets next sixty days. E. CROFT, PROCTOR, TEXAS.

NEW MEXICO
STATE OIL AND GAS LEASES
NEW block of leases located in San Juan Co., where pools have been opened which produce the highest gravity crude known in the World today. Rental 15c per acre. Write for information. Buy direct and save those dollars. No middle man to pay; no salesman to bother you.
HARRY S. WRIGHT
New Mexico State Lessee
Wright Bldg., Farmington, New Mexico.

PRODUCTION FOR SALE BY COMPANY OWNER

11 Bartlesville sand wells on 180 acres Nowata County, Oklahoma. Pumping $200.00 per month income. All acreage proven. Good lease house and water. Ideal proposition if you desire to live upon and operate. Brokers and Junk Dealers need not inquire. $7,500.00 Cash. Box A-201 The Oil and Gas Journal, Tulsa, Okla.

5500 VIRGIN structural acreage. 520 foot flowing well near. Bargain to right people. N. M. SAULS, Geologist, Cookeville, Tennessee.

FOR SALE—Oil and gas leases Kentucky shallow field, adjoining producing oil and gas wells. Some leases adjacent to contracted Drilling Block. Excellent opportunity to make real money from small investment. Address P. O. Box 2117, Washington, D. C.

ATTENTION DRILLERS! 25000 acres under lease. Block for sale or development N. E. Miss. Geologist report A-1 Structure. Good proposition for major Co. or wildcat operator. Wire, Phone or Write T. Y. Johnson, Box 357, Starkville, Miss.

TO TRADE—200-acre lease or more near well now drilling IN BATES CO., MO., for '39 or '40 car. Alco acreage for sale. Good opportunity. JOHN EGER, Rich Hill, Mo.

Leases and Drilling Blocks

CRANE CO., oil possibilities, cheap fee land, 3 mi. E Ward Gulf-Western drilling. J. G. SMITH, 215 Littlefield Building, Austin, Texas.

FOR lease 130,000 ac. in Tennessee's coal basin, on world's largest timbered plateau. Part of Appalachian coal, oil and gas field. Oil being refined here now from shallow wells. Stanolind and other large companies have leases here. G. E. HARRISON, Crossville, Tennessee.

WANT small rotary to drill 1500 feet in proven territory on interest deal in central Oklahoma. Ted E. Ferren, 113½ East 17th St., Falls City, Nebraska.

Legal Blanks

BURKHART'S legal blanks and general forms serving Mid-Cont. oil field since 1908—Okla. Kans. N. Mex. Tex. Ala. Ark. Fla. Ga. Ill. Ind. Ky. La. Mich. Miss. Mo. Neb. N. Dak. Tenn. Wyo. Free catalog samples on request. Burkhart Ptg. & Sta. Co. 115 S. Cinn. Tulsa, Oklahoma.

Oil Industry Printing

OIL FIELD LEGAL BLANKS
Leases, assignments, releases, township plat books, well records, etc. Request on your letterhead gets free catalog. Olds Press, 215 East Third St., Tulsa, Okla.

Financing

JOHN MORRIS, Box 5411, Philadelphia, studied records 5000 financial houses. Found only 191 buy new issues. $4.00.

Survey Service

REMEMBER EAST TEXAS
When all other methods fail, employ my divining or dowsing method. If oil exists this method finds it. Faults, broken treacherous areas accurately defined. Our Watson #2, first producer Wilmington, Calif., field, located by this method. More reliable than mechanical geophysics. Ask any unbiased oil authority. Many years' experience. A wise man investigates. George Miller, 1548 Post, Torrance, California.

Ranches—Farm Lands

129,000-A Ranch NW of Roswell, N. M., mtn. slope and prairie, fine grass and water, 11 springs, lakes, 20 mi. running streams, hiway, at $250,000. Howard Ingram, Perrine Bldg., Oklahoma City, Okla.

Money Raising

$25,000 LOAN WANTED. Texas factory, water meters, cotton gauze. Estab. 1929. J. L. Arlitt, 17 E. 42nd, New York.

WANTED. Capital to develop shallow 100% leases in Southwest. Box A-230, The Oil and Gas Journal, Tulsa, Oklahoma.

Royalties

ANDREW J. BARRETT
The Philtower
Tulsa, Oklahoma

Brokers—Salesmen

Sell in the most active area in the United States—The Permian Basin of West Texas and Southeastern New Mexico. From the standpoint of royalty investors this area has much to offer. Can supply you with choice non-producing royalties located on geophysical highs. Also drilling blocks, close in acreage to production, or wildcat leases. I maintain my own field men who cover this area for me. All offerings meet the requirements of the Security and Exchange Commission. Inquiries invited.

B. D. BUCKLEY
Paul Brown Bldg., St. Louis, Mo

ROYALTY under TEST WELLS drilling by Major Oil Companies seeking to open NEW, DEEP OKLAHOMA OIL FIELDS. WE HANDLE NOTHING PROMOTIONAL. Ask for Current Prices and Schedules B. W. E. Cook, Wholesale Royalty Dealer, Perrine Bldg., Oklahoma City, Okla.

WE MAINTAIN A MAKET FOR REGISTERED DEALERS IN ALL FORMS OF OIL INVESTMENTS

FIRST DEPENDABLE OIL CORP.
522 Fifth Ave., New York, N. Y.

Mailing Lists

ROYALTY owners, Oil investors, Unit holders, Stockholders in Oil and Royalty Companies. Personnel lists of every branch of oil industry. All by States. We buy lists. New catalogues ready. Oil Industry Mailing List Co., Tulsa Loan Bldg., Tulsa, Oklahoma.

Incorporations

DELAWARE CHARTERS: Complete service $35. Submitted forms. Chas. G. Guyer, Inc., Wilmington, Delaware.

CAPITAL SEEKERS
Put your project before 260 Key-Men. Cost trifling. Details free. AMSTER LEONARD, Fox Theater Building, Detroit, Michigan.

Situations Wanted

REFINERY Maintenance and Construction Engr.; 15 yrs. experience in field and office with same company (Mid-Continent Field). Desire connection as Maintenance or Construction Superintendent. Excellent references. Box A-210, The Oil and Gas Journal, Tulsa, Oklahoma.

CHIEF CHEMIST and PROCESS SUPERVISOR. M.I.T. graduate Chemical engineering. Experienced management, processing, operation, research and development. Fifteen years' experience in refining includes light oils, lube oils, waxes, asphalts, greases, specialties. Presently employed as refinery superintendent but seeking more progressive connection. Address Box A-213, The Oil and Gas Journal, Tulsa, Oklahoma.

REFINERY Superintendent-Chemist—20 years' experience practical designing, operation, construction, supervision in skimming, cracking and gasoline plants. Open for job. Box A-232, The Oil and Gas Journal, Tulsa, Oklahoma.

YOUNG man, 10 years oil field drilling-production and office experience, intelligent and progressive, desiring new connection. Go anywhere. Write Box A-231, The Oil and Gas Journal, Tulsa, Okla.

Help Wanted

DRILLING mud engineer, with adequate laboratory and field experience for sales development. Replies should give full details including education, experience, age and salary expected. Box A-211, The Oil and Gas Journal, Tulsa Okla.

REFINERY (cracking) plant supt., also asst. supt. Give past operating exp., edu. and other details. Address Box A-235, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED: Man acquainted with producers to buy Thread Protectors. Must have pick-up truck. Excellent opportunity. Give full details about yourself in first letter. Box A-234, The Oil and Gas Journal, Tulsa, Oklahoma.

For Sale—Maps

1940 OIL AND GAS FIELD MAP
Texas, Eastern New Mex. Price $1.00.
Wildcat Map $3.00 Published monthly
ZINGERY OIL MAP CO., Fort Worth, Tex.

Geophysical Service

ATTENTION. Why not locate Oil? A dry structure is not profitable. Unless we locate the Oil and Gas for you you pay us nothing for the survey. Maps and written reports furnished free. A Direct Geophysical Method that you can understand. Write Gravitational Selector, 14957 Lakewood Heights Boulevard, Lakewood, Ohio.

Municipal Bonds

$10,000 South Houston, Texas, 3% to 5% suburb Houston. Income tax free. J. L. Arlitt, 17 E. 42nd, New York.

Equipment Wanted

WANTED used pipe threading and cutting machine in good condition, with a range of size from 1 to 4" or 1 to 3". Landis or Bignall & Keeler preferred.
DONLEY PIPE & SUPPLY COMPANY
3324 N. Broadway, St. Louis, Mo.

WANTED
LEEDS & Northrup instruments, controlling pyrometers, all makes, obsolete and defective types considered. When appropriations are hard to get, use our offer for surplus and obsolete pyrometers to get new equipment. Box A-233, The Oil and Gas Journal, Tulsa, Oklahoma.

For Sale—Equipment

FOR SALE

30-TON S/G LIMA GASOLINE, 0-4-0 SWG. LOCO. NEW 1931, GOOD COND ROLLER BEARING. Immed. Delivery SEND US YOUR INQUIRIES FOR ANY KIND OF LOCOMOTIVES

IRON & STEEL PRODUCTS, INC.
13412 S. Brainard Ave.
Chicago, Ill.

"Anything containing IRON or STEEL"

CLASSIFIED ADVERTISING RATES

Classified advertising rates: First insertion, 35 cents a line; each additional insertion, 25 cents a line, PAYABLE IN ADVANCE. Six words usually make a line. Count as a word each one-letter word and each group of figures. White-space computed at regular line rate. Allow two extra lines for blind ads. Ads of less than three lines not accepted. No formal acknowledgment is made, and proofs cannot be shown in advance of publication.

	1 time	2 times	3 times	4 times		1 time	2 times	3 times	4 times
3 Lines	$1.05	$1.80	$2.55	$3.30	7 Lines	$2.45	$4.20	$5.95	$7.70
4 Lines	1.40	2.40	3.40	4.40	8 Lines	2.80	4.80	6.80	8.80
5 Lines	1.75	3.00	4.25	5.50	9 Lines	3.15	5.40	7.65	9.90
6 Lines	2.10	3.60	5.10	6.60	10 Lines	3.50	6.00	8.50	11.00

CLASSIFIED DISPLAY RATES

Classified Display is set with a border and may be used in one or two column sizes.

1 Inch	1 time	$5.00
1 Inch	13 times	4.50 per inch
1 Inch	26 times	4.00 per inch
1 Inch	52 times	3.50 per inch

This space may be contracted for over a period of one year from the date of the first insertion and is PAYABLE IN ADVANCE, MONTHLY.

We reserve the right to withhold all advertising of questionable character. To avoid delay be sure to send remittance with copy. We will set your ad in the smallest amount of space possible and refund all overpayments. One-time insertions will not be run until fully paid. Forms close MONDAY NOON before each issue date.

THE OIL AND GAS JOURNAL
Tulsa, Oklahoma

FOR SALE

One gasoline drilling rig with two 85 H.P. Waukesha motors and unitized draw works complete.

300 sets 3" A.P.I. tool joints.

10,000 Ft. 7" O.D. 26# seamless casing, once run.

15,000 Ft. 4½" O.D. seamless drill pipe equipped with both regular and full hole tool joints.

In addition to the above we have 20,000 Ft. screw line pipe in Oklahoma; also drilling rig capable of drilling to 6500 feet, complete stock of line pipe, casing, drilling and pumping equipment.

Wire, Write or Phone for Prices.

Louisiana Iron & Supply Co.
Shreveport, La.

LIQUIDATING BARNSDALL REFINERY—OKMULGEE, OKLAHOMA

Will Sell All or Any Part

Prices Quoted Where Located or f.o.b. Cars

—Send us your Inquiries—

New, Complete Inventory Will Be Available Immediately

Send Us Your Name and Address

SONKEN-GALAMBA SUPPLY COMPANY

W. C. Berry and H. J. Galamba
Riverview at Second, Kansas City, Kansas

Robt. W. Duden
2100 S. Union, Tulsa, Oklahoma

MUST VACATE PREMISES

Will Sacrifice

ALCORN REFORMING FURNACE

Practically New—Built 1935—In Service Short Time
Former Shell Refinery—Arkansas City, Kansas

WILL SELL UNIT COMPLETE—OR MAJOR SECTIONS SEPARATELY

Description

Type: Alcorn suspended wall and flat roof arch. 140 tubes. Tubes Nos. 1 to 82, inclusive—3" OD × 5/16" minimum wall; 23' 5" long. Tubes Nos. 83 to 140 inclusive—3½" OD × 3/8" minimum wall; 23' 5" long.

Composition of Tubes: Roof of heating section, floor and roof of soaking section are hot finish seamless carbon steel with 2% chrome, .5% Molybdenum. As per manufacturer's standard specifications No. 100 (7-35), all others same except no Molybdenum.

Type of Return Bends: Key box type, part are key B-8850 and part key B-8846, all are series 7000. All Corner Fittings, Return Bends, Plugs, Screws and Rings are of K-4 Alloy or 4%-6% Chromium and .5% Molybdenum. Key B-8850 are 3" × 5½"; Key B-8846 are 3½" × 6⅛".

No. and Type of Burners: Sixteen concentric gas and oil burners, eight on each side of furnace.

Dimensions of Furnace: 30' 0" × 30' 0" × 12' 4".

New 3" OD x 23'5" carbon steel, Moly AASM 200, and Cedarmoly cracking tubes.

BROWN-STRAUSS CORPORATION

1446 Guinotte
Kansas City, Mo.

Representative at Arkansas City Office at all Times.

Arkansas City,
Kansas

SIDEBOOMS FOR SALE

1 Cat 30 Sideboom, 1 T-40 Sideboom, excellent condition, priced reasonable. ready to work. Terms can be arranged. Write F. C. Ewing, P. O. Box 2552, Houston.

NOTICE — CABLE-TOOL CONTRACTORS, Save money; good used wire lines. All sizes up to 5,000 ft. long. See us before you buy. General Tool & Supply Co., P.O. Box 4387, Oklahoma City, Oklahoma.

FOR SALE—USED BOILERS

3 90HP-225SWP Acme Oklahoma City

LUCEY PRODUCTS CORPORATION
TULSA

TWO WELL SERVICING UNITS, one 30 and one 60 model Caterpillar tractors with Cardwell and Hopper winches respectively, A-1 condition, priced reasonably with terms. Paul Rutledge, 424 N. Cincinnati, Tulsa, Okla.

CRUDE-OIL PRICES IN REPRESENTATIVE FIELDS

Complete crude-price schedules are now being published in the first issue of each month. The last complete schedule was published in the October 3 issue. All changes in crude-oil-price schedules will be published completely in the first issues following the announcement of the changes. Following are representative crude-price schedules in barrels (42 gal.):

East Texas	$1.10
Conroe	1.27
Tepetate, Louisiana	1.03
Smackover, Arkansas, heavy	.73
Illinois basin	1.15
Pecos County, Texas	.78
Lance Creek, Wyoming	.77
Bradford, Pennsylvania	1.85

Gravity Schedules

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

	Hill, California* Signal	Oklahoma, Kansas	Coast, Texas Gulf
14-14.9	$0.65	....	....
15-15.9	.65	....	....
16-16.9	.65	....	....
17-17.9	.65	....	....
18-18.9	.65	....	....
19-19.9	.69	....	$0.86
20-20.9	.73	$0.70	.88
21-21.9	.78	.72	.90
22-22.9	.82	.74	.92
23-23.9	.86	.76	.94
24-24.9	.90	.78	.96
25-25.9	.95	.80	.98
26-26.9	.99	.82	1.00
27-27.9	1.03	.84	1.02
28-28.9	1.07	.86	1.04
29-29.9	1.10	.88	1.06
30-30.9	1.14	.90	1.08
31-31.9	.92		1.10
32-32.9	.94		1.12
33-33.9	.96		1.14
34-34.9	.98		1.16
35-35.9	1.00		1.18
36-36.9	1.02		1.20
37-37.9	1.04		1.22
38-38.9	1.06		1.24
39-39.9	1.08		1.26
40-40.9	1.10		1.28

*Effective Feb. 1, 1940.

Crude-Oil Price Changes

South Penn Oil Co. increased Bradford-Allegany, Southwest Pennsylvania and Eureka grade crudes 15 cents per barrel effective November 12.

Eastern States

SOUTH PENN OIL CO.
(Effective November 12, 1940)

Pennsylvania Grade oil in National Transit lines (Bradford field)	$2.00
Pennsylvania Grade oil in Southwest Pennsylvania lines	1.65
Pennsylvania Grade oil in Eureka Pipe Line lines	1.59
Corning grade oil in Buckeye Pipe Line Co. line	1.12

Retroactive to November 1, Panhandle Refining Co. returned to the regular gravity scale crude-oil price posting in the North Texas district, less the actual cost of transportation. In effect, the Panhandle restored the regular gravity scale at the refinery instead of at the well. The company abandoned its flat "at the well" posting of 75 cents per barrel which had obtained since July 16.

REFINERY GATE VALVES

Reconditioned and Tested
STEEL and CAST IRON
O.S.&Y. Flanged and Screw End
ALL STANDARD MAKES
Largest Stock in Midwest
We save you half

West Tulsa Pipe and Supply Co.
L.D. 635 P.O. Box 1865
TULSA, OKLAHOMA

25 K.W. and 40 K.W. Gas Engines, 220 volts, D.C. Two 100 K.W. Gas Engine-Generator Sets, 220 volts, D.C. 7x6 Ingersoll-Rand ER-1 Air compressor. Six-inch Oster Pipe Threading Machine. Also large stock of lathes, pipe machines, milling machines, etc. Send for our list.

Terms to suit.

CINCINNATI MACHINERY & SUPPLY CO
26 West 2nd St., Cincinnati, Ohio

ONE 7' x 12' two-door steel tool house. One 4-in-line roller bearing crown block with 36" manganese steel sheaves on 20" beams. A-1 shape. 1300 Ramsey Tower. Oklahoma City, Oklahoma.

TRACTORS

Caterpillars, crawler type, size "35," $375; size "65" with nigger-head winch, $750; Caterpillar RD8 with bulldozer, $2000; Allis-Chalmers Model L with bulldozer $1750. Guaranteed, slightly used. O. C. Evans, Mt. Sterling, Ky.

YOUR dependable and cheapest source of supply!
Tank & Freight Cars; any kind
Tank & Freight Car Repair Parts; all kinds Locomotives; all types
Relaying Rails
Perhaps *we* can supply your requirements and — immediately!
OTHER MACHINERY AND EQUIPMENT TOO!
Destination inspection if desired!
IRON & STEEL PRODUCTS, INC.
13412 S. Brainard Ave., Chicago, Ill.
"Anything containing IRON or STEEL"
Ask to be placed on our various mailing lists.

Gulf Coast Markets

(Continued from Page 263)

scheduled to be moved before November 1. There was some additional movement of gasoline the past week on earlier sales, including one cargo of gasoline to Japan.

The inactivity prevents gasolines from taking a firm stand, and quotations are subject to concessions.

New York Markets

(Continued from Page 263)

to indications, all heavier oils may witness further increases. The possible improvement in bright and cylinder stocks would reverse the former relationship with neutral oils which up until the present were well maintained. The improved position of cylinder stocks is linked to the recent improvement in industrial activity since industry is a large consumer of heavy lubricating oil.

Tank-Wagon Changes

(Continued from Page 264)

Tenn., November 6. On November 4 the company reduced tank-wagon and tank-car prices of regular and premium gasolines 0.5 cent per gallon in Tennessee, Arkansas and Louisiana, except at points previously subnormal. Reductions applied to Baton Rouge, Alexandria, Lafayette, and Lake Charles, La.; Knoxville, Memphis, Chattanooga, Nashville, and Bristol, Tenn., and Little Rock, Ark. Reductions in the dealer-tank-wagon price of 0.5 cent per gallon were applied to Baton Rouge, Alexandria, Lafayette and Lake Charles, La.

INDEX TO ADVERTISERS

A

Abercrombie Pump Co. 170
AC Spark Plug Division of General Motors Corporation
Acme Fishing Tool Co. 241
Acme Gas Lift Company 163
Aero Exploration Co.
Air Reduction Sales Co. 1
Ajax Iron Works
Alco Products Division of American Locomotive Company 11
Allis-Chalmers Mfg. Co.
Allison, R. J.
American Blower Corporation
American Bosch Corporation
American Cable Division of American Chain & Cable Co., Inc.
American Cast Iron Pipe Company
American Hoist & Derrick Co. 164
American Iron & Machine Works
American Lecithin Co., Inc. 135
American Locomotive Company, Diesel Engine Division 174
American Meter Company 193
American Roller Bearing Co. 116
American Rolling Mill Co., The
American Steel & Wire Company 20
Armstrong Bros. Tool Co.
Armstrong Machine Works 38-246
Ashcroft Gauge Division 146
Athey Truss Wheel Co.
Auer, C. L., and W. W.
Austin-Western Road Machinery
Axelson Manufacturing Company

B

B and M Construction Corp.
Baash-Ross Tool Company 172
Babcock & Wilcox Tube Company, The 183
Badger & Sons Co., E. B. 156-204
Baker Oil Tools, Inc.
Baldwin-Duckworth Division of Chain Belt Company
Bantam Bearings Corp. 25
Baroid Sales Division, National Lead Company 220-221
Barret, William M., Inc. 258
Beaird Corporation, J. B. 236
Bethlehem Supply Company
Bethlehem Steel Co. 6
Braden Steel Corporation
Brance-Krachy Co., Inc.
Brauer Machine & Supply Company
Brewster Company, The
Bridgeport Machine Company, The
Bristol Company, The 214-215
Broderick & Bascom Rope Co.
Brodie Co., Ralph N.
Brown Instrument Company, The 34
Bruning, Charles Co., Inc.
Buchanan, Al, Drilling Co. 200
Buck Clamp Company
Buckeye Traction Ditcher Co. 129
Bucyrus-Erie Co.
Buda Co., The 66
Burgess Battery Co.
Burke-Greis Oil Corp. 169
Butler Manufacturing Co.
Byron Jackson Co.

C

Cable, Jo H. 244
Cameron Iron Works, Inc.
Cardwell Mfg. Co., Inc.
Carey Company, The Philip 17
Carnegie-Illinois Steel Corporation 40
Cast Iron Pipe Research Association, The 76
Caterpillar Tractor Co.
Cavins Company 246
Century Electric Company 10
Cessna Aircraft Company
Chain Belt Company 19
Chaplin-Fulton Mfg. Co., Inc. 175
Chapman Valve Mfg. Co., The 197
Chevrolet Motor Division, General Motors Sales Corporation
Chicago Bridge & Iron Company 186-187
Chiksan Tool Co. 247
Clark Brothers Company 132-133
Classified Advertising 268-269
Cleveland Trencher Company 166
Climax Molybdenum Company 222
Columbia Steel Company 20-40-147
Columbian Steel Tank Co. 119
Continental National Bank of Fort Worth 173
Continental Motors Corp.
Continental Oil Co.
Continental Supply Company, The 115-130
Cooper, Fred E.
Cooper-Bessemer Corp., The 108
Core Laboratories, Inc.
Crane Co. 7
Cummins Engine Co.
Crutcher-Rolfs-Cummings
Curtin, W. H. & Co., The 247

D

D & M Machine Works
Darling Valve & Mfg. Co. 202
Davis Regulator Mfg. Co., The 200
Dayton Rubber Mfg. Co., The 130
Dearborn Chemical Co. 153
Deep Rock Oil Corp. 240
Dempsey-Wilson Construction Co.
Diamond Chain & Mfg. Co.
Dodge Division, Chrysler Corporation 22
Dowell Incorporated
Dragon Mfg. Co., The
Dresser Mfg. Co., The 101
Drilling Equipment Directory
Duff-Norton Manufacturing Co., The
Du Pont de Nemours & Co., Inc.
Durametallic Corp.

E

Eagle-Picher Lead Co. 140
Eastman Oil Well Survey Co.
Economy Electric Lantern Co.
Elastic Stop Nut Corp. 258
Electrical Facilities, Inc.
Emsco Asbestos Company 246
Emsco Derrick & Equipment Company ..... Inside Front Cover
Engineering Laboratories, Inc.
Ensign Carburetor Company, Ltd.
Ethyl Gasoline Corporation

F

First National Bank of Fort Worth 173
First National Bank in Houston 146
First National Bank & Trust Co. of Tulsa, The 142
Fisher Governor Company
Fluid Packed Pump Co.
Fluor Corporation, Ltd., The 151
Ford Motor Co.
Fort Worth Chamber of Commerce
Fort Worth Clearing House Association 173
Fort Worth National Bank, The 173
Foster Wheeler Corp. 28-29
Foxboro Mfg. Co., The
Franks Mfg. Co. 148
Frick-Reid Supply Corporation 165

G

Gardner-Denver Company 18
Garlock Packing Company, The
Gaso Pump & Burner Mfg. Co.
Gasoline Products Co., The 8
Gates Rubber Co., The
Gatke Corporation 170-247
General American Transportation Corporation—Terminal Division 138
General Electric Company 32
General Paint Corporation 180
General Power, Inc.
Geological Scientific Service Company
Geophysical Service, Inc. 121
Gilmer Company, L. H. 2
Girdler Corporation, The 14
Glidden Company, The 135
Goodall Rubber Co. 127
Goodrich Company, B. F., The 3
Goodyear Tire & Rubber Co.
Gott, H. P., Mfg. Co. 149
Graver Tank & Mfg. Co., Inc. 35
Gray Processes Corporation, The 44
Great Lakes Steel Corporation
Green Head Bit & Supply Co.
Guiberson Corporation
Gulf Oil Corp.
Gulf States Utilities Co. 226

H

H & M Pipe Beveling Machine Co.
Halliburton Oil Well Cementing Co.
Hanlon-Buchanan, Inc. 50
Harley Sales Co.
Harnischfeger Corporation 154
Harris, Upham & Co. 258
Harrisburg Steel Corporation 131
Hazard Wire Rope Division of American Chain & Cable Co., Inc. ..... Inside Back Cover
Helmerich & Payne, Inc. 153
Hewitt Rubber Corp.
Hill-Hubbell & Co. 180
Houston Engineers, Inc.
Houston Oil Field Material Co. 141
Houston Pipe Appliance Co.
Hughes Tool Co. ..... Back Cover
Humble Oil & Refining Co. 210-211
Hydril Co. ..... Front Cover

I

Independent Exploration Company
Industrial Engineering Co.
Inferno Co., The
Ingersoll-Rand Co. 30
International Harvester Co. 84
International Nickel Company, Inc., The 48

J

Jadson Motor Products Company
Jarecki Manufacturing Company
Jensen Brothers Manufacturing Co.
Jerguson Gage & Valve Co.
Johns-Manville Corporation 27-255
Jones Company, The S. M.
Jones & Brooks, Inc. 225
Jones & Laughlin Steel Corporation

K

Kellogg, M. W., Company, The 168-207
Kennedy Valve Mfg. Co., The 184
Kerotest Manufacturing Company
Keuffel & Esser Co. 36
Key Company
Kobe, Incorporated

L

Laminated Shim Company, Inc.
Landis Machine Company, Inc. 4
Lane-Wells Company
Larkin Packer Company, Inc.
Layne & Bowler, Inc. 257
Leeds & Northrup Co.
Le Roi Company 232
Leschen, A., & Sons, Rope Co. 74
Lincoln Electric Company, The
Line Scale Co., Inc.
Link-Belt Company 175-177
Lockheed Aircraft Corporation 137
Lone Star Cement Corporation
Long, S. A., Co., Inc.
Lucey Export Corporation 160
Ludlow Valve Mfg. Co., The 206
Lufkin Rule Co. 252
Lummus Co., The 198
Lunkenheimer Co., The 31

Mc

McEvoy Company 144
McGregor Working Barrel Company 255
McKissick Products Corp.

M

MacClatchie Manufacturing Company 246
Macwhyte Co.
Magnolia Airco Gas Products Co. 1
Maloney Tank Mfg. Co.
Manhattan Rubber Mfg. Division
Manning, Maxwell and Moore, Inc. 146
Marley Company, The 181
Marmon-Herrington Co., Inc. 192
Marsh, James P., Corp. 162
Martin-Decker Corp.
Mayfair Hotel 169
Medart Company 182
Meehanite Research Institute
Merco Centrifugal Co.
Merco Nordstrom Valve Co. 189-190
Mercoid Corporation
Metric Metal Works 193
Mid-Continent Engineering Co., Inc.
Mid-Continent Petroleum Corp. 152
Mid-Continent Pump Supply Co. 139
Mid-Continent Supply Company
Midwest Piping & Supply Company, Inc., The 134
Miller Sand Pump Co.
Mission Mfg. Co., The 178
Monsanto Chemical Company 24-33
Morse Chain Company 106
Murray Rubber Company

N

National Bank of Tulsa 37
National Carbon Co., Inc.
National Steel Corporation
National Supply Co., The 102-103
National Transit Pump & Machine Co.
National Tube Co. 147
Nelson, J. B.
New Bedford Cordage Co.
Newman, Hender & Co., Ltd.
Norton Company
Novo Engine Co. 169
Nugent, Wm. W., & Co., Inc.

O

O.C.S. Mfg. Co., The 41
Ohio Injector Co., The 39
Oil Center Tool Co. 233
Oil Well Supply Co.
Oliver United Filters, Inc.
Osage Metal Company
Otis Pressure Control, Inc.

P

Pacific Pump Works 139
Page Fence Association 144
Page Steel & Wire Division of American Chain & Cable Co.
Parkersburg Rig & Reel Co.
Parkhill Truck Co.
Parkhill-Wade
Patterson-Ballagh Corporation 171
Pease, C. F., Company, The 203
Peerless Pump Division of Food Machinery Corp. 65
Penberthy Injector Co.
Pennington Signaling Core Barrel
Pennsylvania Grade Crude Oil Association
Perco, Inc.
Petroleum Advisers, Inc.
Petroleum Electric Power Association 201
Petroleum Rectifying Company
Petty Geophysical Engineering Co.
Phelps Dodge Refining Corporation 164
Pittsburgh-Des Moines Steel Company 16
Pittsburgh Equitable Meter Co.
Pittsburgh Steel Company 195
Plymouth Cordage Co.
Poist Tool Co.
Pomona Pump Co. 45
Portable Rig Co.
Powell, Wm., Co., The 43
Price, H. C., Co. 69
Pritchard, J. F., & Co.
Producing Equipment Directory
Pure Oil Co.

R

Reading-Pratt & Cady Division of American Chain & Cable Co.
Rector Well Equipment Co., Inc.
Reda Pump Co. 205
Reed Roller Bit Company 112
Regan Forge & Engineering Co.
Reilly Tar & Chemical Corporation 241
Republic National Bank of Dallas
Republic Rubber Division of Lee Rubber & Tire Corp.
Republic Steel Corporation 13
Rockford Drilling Machine Division of Borg-Warner Company
Roebling's Sons Company, John A.
Ryerson & Son, Inc., Joseph T.

S

Safety Gas Main Stopper Co.
Schlumberger Well Surveying Corporation 98
Sealed Power Corp.
Security Engineering Co. 256
Seismic Explorations, Inc.
Seismograph Service Corp.
Shafer Bearing Corporation 237
Shand & Jurs Co.
Shell Development Company
Shell Oil Company, Incorporated
Sinclair Refining Company, Inc. 23
Skelly Oil Company 196
Skinner Co., M. B.
Smith, A. O., Corporation 5
Smith Company, E. M. 213
Smith Company, Howard 70
Smith, H. C., Oil Tool Co. 247
Smooth-On Mfg. Co., Inc. 244
Socony-Vacuum Oil Co., Inc.
South Chester Tube Co. 111
Southwestern Gas & Electric Company
Spang Chalfant, Inc. 86
Spang & Company
Sperry-Sun Well Surveying Co. 218
Spicer Mfg. Corp. 136
Standard Oil Company (Indiana) 236
Standco Brake Lining Co. 246
Stanley Belting Corporation
Star Drilling Machine Co., The
Stearns-Roger Manufacturing Co.
Steel Founders' Society

T

Tansel Petroleum Co.
Taylor Forge & Pipe Works 79
Taylor Instrument Companies
Technical Oil Tool Corporation, Ltd.
Texaco Development Corporation
Thermoid Company
Thornhill-Craver Co.
Thornton Tandem Co. 199
Timken-Detroit Axle Co. 42
Timken Roller Bearing Company 15
Timken Roller Bearing Company, Steel and Tube Division 47
Tobin, Edgar, Aerial Surveys 225
Toledo Pipe Threading Machine Co., The
Tretolite Company
Trinity Portland Cement Company 21
Tru-Line Corporation
Tubbs Cordage Co.
Tube-Turns, Inc. 185
Tulsa Boiler & Machinery Co. 194
Twin Disc Clutch Co. 157

U

Union Wire Rope Corporation 46
Unit Rig & Equipment Company 155
United Gas Pipe Line Co.
United Geophysical Co.
United States Rubber Company
United States Steel Corp., Subsidiaries 20-40-147
United States Steel Export Company 20-40-147
Universal Atlas Cement Co.
Universal Engineering Company, Ltd.
Universal Oil Products Co. 73

V

Vickers, Inc.
Viking Pump Co.
Visco Products Company 83
Vogt, Henry, Machine Co. 26

W

Walker, W. L., Co. 225
Wall-Colmonoy Corp. 164
Wall Rope Works, Inc. 246
Walworth Co.
Warren Petroleum Corporation 167
Waukesha Motor Co. 124
Wedge Protectors, Inc. 252
Weil Equipment Manufacturing Corp.
Weil Surveys, Inc.
Western Geophysical Company
Westinghouse Electric & Mfg. Co. 12
Wheeling Machine Products Company 136
Whitney Chain & Mfg. Co.
Wickwire Spencer Steel Company 81
Wilson Manufacturing Co., Inc. 145
Wisconsin Motor Corporation 256
Witte Engine Works
W-K-M Company, Inc.
Worthington Pump & Machinery Corporation 9
Wyatt Metal & Boiler Works 104

Y

Youngstown Sheet & Tube Co.

The Oil Man's Calendar appears on Page 80